THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES. DEPARTMENT OF FINE ARTS. ILLUSTRATED CATALOGUE OF THE GOODYEAR COLLECTION OF PHOTOGRAPHS OF ITALIAN ARCHITECTURE AND SCULPTURE, AND OF THE SURVEY OF ITALIAN MEDIEVAL BUILDINGS

NORTH PORCH OF THE NEW MUSEUM OF THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

DEPARTMENT OF FINE ARTS

ILLUSTRATED CATALOGUE

OF THE

Goodyear Collection of Photographs

OF

ITALIAN ARCHITECTURE AND SCULPTURE, AND OF THE SURVEY OF ITALIAN MEDIÆVAL BUILDINGS.

The Original Observations, Choice of Subjects and Catalogue Text by
PROFESSOR WM. H. GOODYEAR.

The Negatives, Prints, Bromide Enlargements, and Cartoons of the Survey by
MR. JOHN W. MCKECKNIE.

The
Architectural Record.

VOL. VI. JULY-SEPTEMBER, 1896. No. 1.

OPTICAL REFINEMENTS IN MEDIÆVAL ARCHITECTURE.*

Report of the Brooklyn Institute Survey, May–October, 1895.

I.

ADMIRATION of the mediæval cathedrals is so much a matter of course nowadays that all persons inside the pale of European civilization are expected to feel it and to give expression to it, consequently they all do it. How far this admiration is a matter of fashion and how far it is really felt is, however, an open question. Historic associations and the romance connected with them will carry people a long way in Westminster or at Canterbury. The mediæval cathedrals are, generally, larger buildings than their modern copies, and in so far are calculated to excite admiration by this fact of their dimension, which is, of all elements in building, the most obvious and the most easily understood. It is, however, extremely doubtful whether the finest qualities of the mediæval cathedrals are those which generally excite the warmest admiration. Otherwise it would be extremely difficult to understand why the deficiency of these qualities is so complacently tolerated in modern buildings at once by architects and by the general public.

When Viollet le Duc said "Our streets are deserts for thought; they have all the monotony of the desert without its compensating loneliness," he was thinking of the coldness of their strict symmetry, the monotony of their mathematical regularity and of their mechanically repeated and mechanically executed details.

Our modern architectural crime, which cries aloud to heaven for reprobation, is deficiency of the picturesque. An old barn or an old farm house are a thousand times more interesting than the New York Post Office and a thousand times more interesting than a good many other buildings which it is not quite so fashionable to sneer at. This deficiency of the picturesque is largely an inevitable result of our social conditions, but that is no reason

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why it should not be recognized and deplored.

In an old cathedral every capital, every gargoyle, every finial, every window, every statue, was an independent creative effort of the individual artisan. The designs were not passed over to the workman from an architect's office. The workman himself created the design.

Hence the infinite variety of mediæval detail which is one grand source of the picturesque character of mediæval building. Variety was an inevitable result when every workman did his own designing in detail, from the mere fact that many different workmen were employed; and the individual workman varied his own detail from one form to the next corresponding one for the same reason that he was himself the inventor of it.

Hence creations like the façades of San Martino, at Lucca, or of San Pietro, at Toscanella, to name two examples out of hundreds, are practically impossible things in modern art. Our façades are designed by an architect, not only as a whole, but also as regards their individual parts. Even where the effort occasionally appears in modern work, to manufacture artificial irregularity in the original design, this manufactured irregularity will never have the spontaneous and unpremeditated variety of the old creation. Generally speaking, even the effort is wanting. Given the effort, we still have to meet the difficulty that the stone-cutter, who works after the pattern which has been manufactured for him and not by him, will never give his cutting the sparkle, the force and the originality which distinguish the handiwork of the artist artisan of the Middle Ages. We have an analogous case in the contrast between the inferiority of our modern marble statues, which are rarely cut by the sculptor himself, and those more vital ones of older art, on which the sculptor himself did the cutting.

It appears, when these facts are examined, that the admitted inferiorities of modern architecture are largely inevitable results of changed social conditions, and that preaching and criticism are ineffective weapons against them. To change our whole social fabric and to abolish the division of labor, which has separated the architect from the master-mason, which has separated the designing clerk in a pent-up office from the stone-cutter on his scaffold—this is the impossible task which the critic must set himself, who wishes to revive the virtues of mediæval building. It is a fact of deep significance that William Morris is a Socialist, that the works of Ruskin are brimful of economic theories. Let these theories be good or bad, wise or foolish, the fact will stand that every true artist of our day is also at heart a social reformer, and it may be that he knows it best who says the least about it.

But there are other differences between a mediæval cathedral and a modern church, besides the differences in the matter of picturesque details. How rarely do we find any exact symmetry in those apparently corresponding parts which belong to the design of the mediæval church as a whole. How frequently do we find variety in the design of two corresponding spires and other irregularities of arrangement. Uniformity, even in the main features of an old cathedral, is rather an exception than a rule.

It is the habit to explain such irregularities as the result of construction at different periods. But this habit of explanation really begs the question as to how they have arisen. A cathedral was frequently two or three centuries in building, it is true, but it is absurd to say that the façade of Dinan or the choir of Mainz (before the recent restoration) showed Gothic pointed work on top of Romanesque simply for this reason. If the sentiment asking for uniformity had existed, could not the later architects have finished the building in the style prevailing when the building was begun? Admitting that one spire of the façade at Tours is later than the other, as it naturally might be, is that any reason why the second spire should not correspond to the first, if the desire had existed to make it correspond?

The fact is simply this, that the

habits of successive architects corresponded to the habit of any one given architect, and that any given architect of the Middle Age habitually introduced any variation into his design which was suggested either by his fancy or by changes of plan made for some definite cause. If, for instance, he had finished one spire and had a chance to improve the design of its fellow, either because more money and more work on it were available, or because he discovered a defect which might be avoided, or an improvement which might be added, there was nothing in the ethics of his profession or in the prejudices of his time which would antagonize such changes.

To understand an old cathedral we must begin with the union in one person of the artist and the artisan. The picturesque variety springing from the creative capacity of the individual mason and the individual stone-cutter ran all through the building. The architect himself was simply a master-mason, *i. e.*, he was himself a mason by profession. He was not isolated in an office, he was at once architect and builder. It is well known that the first man in Europe who ever proposed to separate the profession of architect and builder was the Florentine Leon Battista Alberti (fifteenth century). The first man in England who ever compelled his wood workers and stone workers to copy *his* designs, for detail, and to give up making their own, was Inigo Jones (seventeenth century).

As long as the architect was the master-mason he was not bound by his own plan. He carried his plan in his head, and on the scaffolds of his building he changed it at will and freely, as he went along.

Therefore, in its whole plan, and also in its details, an old cathedral differs from a modern church as hand-made lace differs from machine work, as a Hindoo rug differs from one made in Yonkers, as a camel's hair shawl differs from a Paisley.

II.

Up to date the element of picturesque irregularity in mediæval architecture has been most potently emphasized and most eloquently described by Mr. Ruskin, especially under the heading of the *Lamp of Life* in the *Seven Lamps of Architecture.*

He has attributed it to a conscious purpose in some definite cases, which he has specifically described, while freely admitting that there is no hard and fast line to be drawn in the examples he has cited between artistic and praiseworthy work, which achieves the element of "life," or of the picturesque, simply because it has not set up a mistaken standard of mathematical regularity—and that work which was consciously and definitely planned to avoid the coldness of strict symmetry.

There is, therefore, an element of irregularity often found in mediæval building which corresponds very closely to the style of decorative design in modern Japanese art—as regards the philosophy of the irregular quality. Clearly the artistic spirit of the Japanese decorative art consciously scorns the trammels of mathematical symmetry, but it would be difficult to say, in a multitude of cases, whether the decorative design is purposely irregular or whether it is so simply because the more difficult and yet inadvisable methods of applying mathematical measurements to decoration are not practiced in Japan.

It is rather difficult for the average taste of modern European and United States civilization to realize the interpenetration of the conscious and the unconscious factors in a really picturesque style, because this modern taste is an extremely vitiated one; judged from the standpoint of the expert in Oriental ornament or in historic design; as regards its preference for mathematical regularity in ornament or its easy toleration of the cold and formal results of such regularity. Many of our most elaborate and pretentious imitations of historic style are ridiculous caricatures of the historic monuments, when the deficiency of the vital element which makes the historic monument interesting, is considered. This vital element has a twofold character—bold contemp

for strict symmetry as regards the whole organism of the building, combined with the inevitable and natural results of leaving individual details to the individual artisan. These last results, of course, can only be imagined as existing in social conditions which made of the artisan an artist having a creative capacity which to-day he has wholly lost.

The century in which division of labor has lowered the capacity of the artisan class, in which machine-made work has accustomed the eye to inartistic uniformity of ornamental detail, in which the specializing of professions and occupations has made it difficult for the educated public as a mass to be thoroughly familiar with even the most elementary canons of artistic taste, in which the habit of slavishly copying old historic styles has crippled original design in architecture, is not very well prepared to appreciate the vitality of mediæval architecture at its full value.

It is, moreover, a point of supreme importance as regards the inherent prejudices and deficiencies, both of uninstructed and also of presumably cultivated modern taste that our architectural traditions, as a matter of strict historic continuity, are those of the late Renaissance in which this vital element and the picturesque quality were wholly lacking. None of the various reactions against these traditions of the cold and formal late Renaissance date back of the last quarter of the eighteenth century. All of these reactions have been artificial revivals of older historic styles; consequently also of a necessarily formal character. How utterly, the modern Greek temple copies, for example, have been wanting in all the most interesting traits of the historic originals has been laid bare by the discoveries of Pennethorne and Penrose, whose first publication is as recent as 1851.

I cannot, therefore, feel it advisable to announce my own discoveries regarding the architecture of the Middle Age without this preliminary effort to clear the way for such announcements. The appreciation of the importance of the observations which I am about to publish will come from persons of artistic temperament already appreciative of the picturesque quality in mediæval building, and especially from those already predisposed to credit the artist *of any period* with knowing fairly well *what* he is doing and *how* he is doing it.

That the artist, in any field of art, pays very much attention to the *why* of his doing I consider rather doubtful, and in so far as my readers prefer my facts to my explanations of them or to the assumption that these explanations represent any definite theories of the builders themselves I shall be well pleased. I believe that every artist works largely from intuition, from feeling, and *from experience.* But if it be assumed that I have attempted to read into some works of the Middle Ages a subtlety and a knowledge of which their builders were naturally incapable, this is an assumption which I should indignantly resent, not on my own account but on theirs.

It is an untenable attitude which exalts or concedes the beauties of the façades at Toscanella as equal to any work in Italy, and which then attempts to explain the ground plans, which I shall publish, as being oblique because the architects did not know a rectangle when they saw it, and as having curves because they did not know how to make a straight line. To say that the interior arches of these churches are of irregular size (in dimensions, which make oversight of the fact impossible,) because the designers were barbarians or careless workmen is to say that the façades are beautiful for the same reason, which is absurd.

All I demand is that the unfamiliar but beautiful buildings which I have examined, such as the Cathedral of Troja, shall be considered as wholes and as works of inspiration throughout, and that the new facts which I shall present for buildings already familiar and already admired shall be understood as having *always* contributed to the beauties *which have been already conceded to exist.* If certain facts about them have been

hitherto overlooked, let us not make the mistake of separating these facts from the effects to which they are the main contributors, of despising or neglecting the study of unknown phenomena *because they are unknown.* A ground plan is not in itself a thing of beauty, sections of churches are not in themselves interesting, measurements are not easy reading, photographic details are not the buildings themselves, but if the results which they represent are an inspiration of picturesque beauty in the given buildings, let us admit that the subject is worth looking into.

III.

I do not lay claim to any originality of presentation or any discovery of facts as to the points so far discussed regarding mediæval irregularities of construction. They have been abundantly and eloquently presented by Mr. Ruskin, especially in his *Seven Lamps*, and especially in the *Lamp of Life.* They are ideas which are certainly felt by every true artist in some way or other, and which may be half-heartedly professed by other men, whose every stroke of work gives the lie to such profession.

As distinct from the mediæval irregularities so far considered there are other phenomena of construction which have so far escaped the attention of science and of the History of Art; phenomena which constantly escape our notice when we are in the buildings; phenomena which were meant not to be seen or noticed, or not to be obtrusive.

There are still other phenomena which have been seen and misinterpreted, which have been attributed to accident when there was no accident, which have been attributed to careless designing when the purpose was subtle, or which have been considered as local mysteries when they have analogies all over Europe.

These phenomena are by no means universal. For the amount of diffusion, for the localities in which they appear most frequently, for the buildings in which they exist or do not exist, I am at present only able to speak definitely, as regards one country in Europe. As far as six months' time would allow me I have made a complete survey and examination of all the mediæval buildings in Italy. This country is, however, undoubtedly the one from which the given phenomena have spread, as far as Northern Europe is concerned, and therefore the one in which a systematic study of them should be first attempted. They are largely or prominently of Byzantine origin.

Among these phenomena I will specify the following:

(*a*) The construction of the piers and vaulting of many mediæval churches in a delicate curve, sometimes leaning into the nave, sometimes bending back from the nave, and in either case making a delicate transition return curve to the arch of the vaulting (Fig. 1). There are no publications extant known to me which specify this feature in mediæval buildings. It easily escapes the eye, even when the observer is familiar with the fact and prepared to recognize it. The minimum amount of this deflection is about three inches, which means very delicate masonry adjustment. When noticed by modern architects it has, as far as I am aware, been referred by them to thrust of the aisle vault against the side of the piers supporting the nave vault or arch. I have naturally prepared myself with the evidence on this head before announcing this feature as a refinement in construction, and will mention here as one instance the case of the Cathedral of Vicenza, where there are no side aisles and where the curving piers face solid chapel walls over 20 feet deep. The curving pier is frequently met in North European cathedrals.

(*b*) A refinement analogous to the last and probably the original and earlier form of it. *It is nothing more or less than the survival of the classic entasis* in the Middle Ages, and is found in the engaged half-columns which occasionally face the Romanesque pier. There are good cases in the Cathedral of Fiesole, and in San Miniato, at Florence. The announcement of the classic entasis as existing

FIG. 1.—PISA CATHEDRAL NAVE.

From a photograph of the Brooklyn Institute Survey. Showing the delicate forward bend of a pier at the Transept. A plumb-line suspended from the gallery shows a deflection of 3¼ inches from the true perpendicular. See text for question of thrust.

FIG. 2.—SANTA MARIA DELLA PIEVE AT AREZZO.

From a photograph of the Brooklyn Institute Survey. Showing an outward lean or spread of the piers in a delicate curve.

in the Middle Ages has been received with surprise and incredulity by certain gentlemen supposed to be experts, to whom I had made the fact known before collecting the evidence now in hand. I shall therefore assume the fact not to be generally known. I will simply add that I was taken last summer to see a case of the mediæval entasis in San Giacomo, at Florence, by Prof. Giglioli, Director of the Natural History Museum of that city. Probably, therefore, I have not imagined it. (See Fig. 11.)

(*c*) A refinement possibly or probably derived from (*a*) and frequently connected with it; a leaning outward and away from the nave of the nave piers, in phases grading from an exaggeration of the backward bend and continuing the curve, to others in which the leaning backward or spread of the piers is in a straight line and not in a curve. This feature has been erroneously ascribed to thrust of the arch or vaulting by architects to whom I have mentioned it. There is a good case at Trani of this lean against the lines of transept walls thirty or forty feet deep. There are other cases of this lean

FIG. 3.—FAÇADE OF THE CATHEDRAL OF FERRARA.

Photographed by the Brooklyn Institute Survey to show the lean.

against solid ancient chapel walls, to which the pier is a facing, in San Eustorgio and in San Ambrogio, at Milan, and in San Francesco, at Pavia. It also occurs in St Mark's, at Venice, and at Santa Maria della Pieve, at Arezzo (Fig. 2), under conditions which make a theory of thrust impossible. In the latter church the outward leans amount to about fourteen inches deflection in a given pier, making a spread of over two feet in the upper nave at the springing of the arch. They are recognized as facts of construction by the local experts, who are not, however, aware of the existence of this spread elsewhere. They are known at Arezzo simply as a local mystery without analogies. There are other cases where thrust cannot be even suggested (by one who has examined the masonry), and I do not know of any case where thrust can be proven or indicated except in the unfinished part of the Siena Cathedral where an original curve has been exaggerated by a thrust, due to non-completion of the building. Cases can be shown in St. Mark's, at Venice, where the leans in the exterior vestibule and within the church are in opposing directions in one and the same wall, showing thrust to be impossible.

(*d*) A system of bends in vertical lines in the exteriors of façades and choirs, differing from some of the interior pier bends in the fact that the lower part of the bend is *always* a forward lean toward the eye facing the wall, and never, as often in the case of the interior piers, a backward lean beginning at the base (as regards the eye of a spectator in the nave facing the pier). The maximum cases of the forward lean are about fifteen inches. There is a fine instance in the Pisa Cathedral façade erroneously ascribed by Ruskin in the *Seven Lamps* to settlement. A number of corroborative cases have been carefully examined for indications of accident (Fig. 3.)

The considerations regarding a settlement of the Pisa façade will be gone into at length. I first announced this lean to be a fact of construction in 1874. The measurements in detail of 1895, taken up to and above the first cornice, are conclusive as to masonry construction. These measurements compel the assumption of a double settlement, if any took place, one sideways and one forwards, and

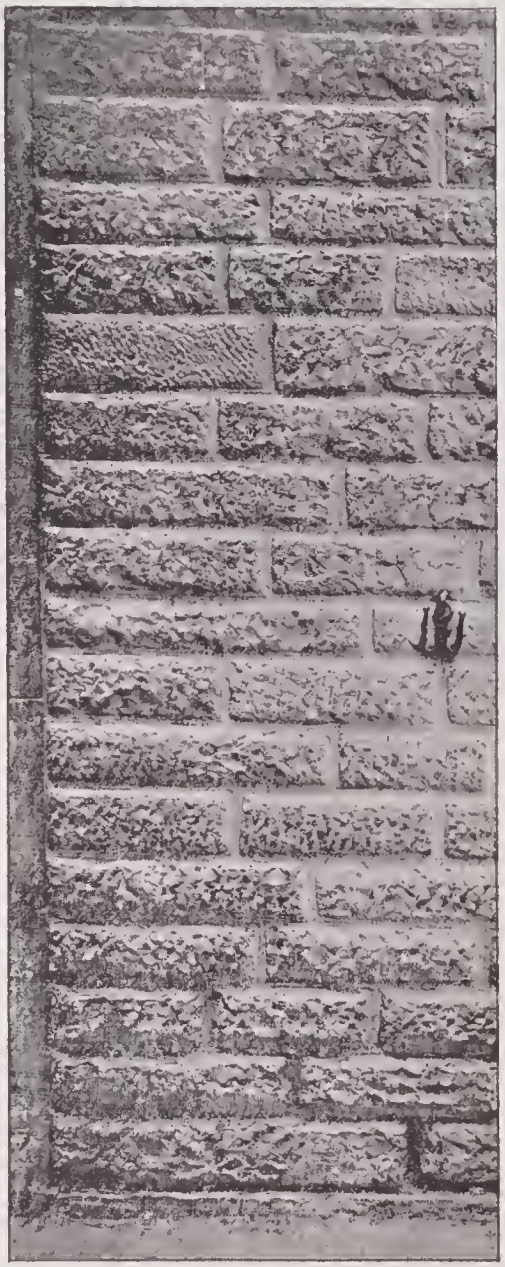

FIG. 4.—MASONRY OF THE BARGELLO TOWER, FLORENCE.

Showing a constructed lean. Photographed by the Brooklyn Institute Survey.

when the theory of a double settlement is applied to the façade cornice the levels taken by Mr. McKecknie show that the façade must have settled laterally *in opposite directions at one and the same time.* The difficulties of the sceptic who asserts settlement for the

FIG. 5 —THE CURVE AT TRANI.

It extends down to the supporting columns and their bases, showing thrust to be impossible. Photographed by the Brooklyn Institute Survey.

Pisa façade are destined in the future to be somewhat amusing.

The survey of the south wall, near the angle of the façade, compels one theory of settlement for the stripes of the masonry, another theory for the pilaster capitals, another theory for the arcades, another theory for the cornice and another theory for the masonry above the cornice. What has misled Mr. Ruskin and many another investigator is a deceptive bend in the masonry stripes for which many analogous cases can be cited in Byzantine construction.

(*e*) Occasional cases of leans in circular buildings or towers which are not due to accident, and tending to raise a question as to others in which the evidence for accident is not clear, but simply presumptive, and based on the supposed improbability that any building made by common-sense morals should be unlike those made by nineteenth century common-sense mortals. Positive cases of lean by construction are the Baptistery of Pisa, the Bargello Tower at Florence (Fig. 4), and the Torre del Publico of Ravenna. (The intention in the case of the Leaning Towers at Bologna is, up to date, the only case conceded.) Two cases of leaning towers in Pisa exhibit curves toward the perpendicular which are analogous to the curves of the leaning façades.

(*f*) Curves in plan of horizontal cornice lines. Many correspond in delicacy to those known for antiquity (see ARCHITECTURAL RECORD for April, 1895), and I am positive that they are a classic survival. A very fine case, where thrust is wholly out of question, is the cloister of the Celestines at Bologna. It is the exact counterpart of the court at Medinet Habou as regards use and place of the curve (see ARCHITECTURAL RECORD,

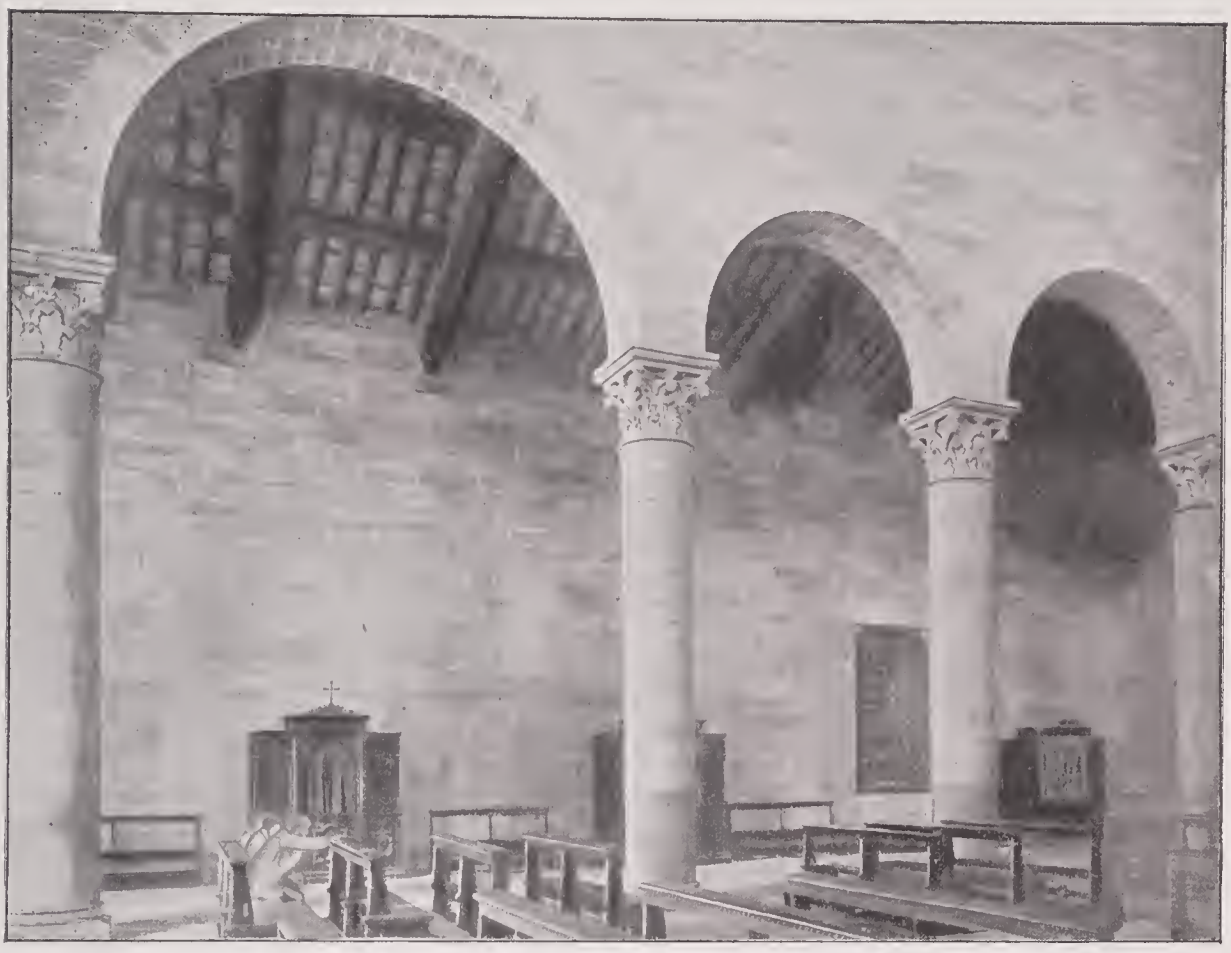

FIG. 6.—ARCHES OF THE FIESOLE CATHEDRAL.

Photographed by the Brooklyn Institute Survey. The maximum diminution in spacing toward the choir is about eight feet.

April, 1895). Many other cloisters to be quoted.

(*g*) Curves in plan in the alignment of columns and in clerestory walls (see Fig. 5) will be specified in detail. Good cases at Fiesole, Genoa, Trani, Ravenna (San Apollinare Nuovo), etc. These curves degenerate in the later Middle Ages into bends which may easily be ascribed to careless building, when considered as isolated cases. Such bends are more probably careless constructions of the earlier and more regular curves.

(*h*) Curves in elevation. There can be no suggestion of thrust for curves in elevation. There can be no suggestion of carelessness for an exact and regular curve in elevation. There can be no suggestion of accident for curves which are invariably curves convex to the sky line. If accidental, why are not some curves concave to the sky line? The announcement that many wholly regular curves, both in plan and in elevation, corresponding in delicacy to those of Greek art, are found in Italy will excite scepticism and derision. I am prepared to meet both, and to furnish the evidence. A good case for a curve in elevation is the alignment of the plinths supporting the columns in the north aisle of the Pisa Cathedral. The chances of accident in this arrangement are 3,628,800 to one against accident.

(*i*) A refinement which consists in increasing the size of the arches near the main entrance of the church and diminishing either space, or height, or both, in the direction toward the choir, thereby giving to the building an effect of greater dimension. The eye is disposed to take a large bay near at hand as the standard of size for all the others. Over thirty different churches in Italy can be specified for

this phenomenon. There is a good case in the Cathedral of Fiesole (Fig. 6). Aside from announcements which I have previously made, there is so far no publication of the fact that these perspective illusions were common in mediæval Europe. It was suggested by a New York architect many years ago to whose attention I had brought certain cases of this peculiarity *in Northern Europe* that the narrowing of arches toward the choir was designed to strengthen the church under the dome or against the arches of the transept. I shall, therefore, take pleasure in publishing a list of Basilicas having this peculiarity which have no transept, and

(*k*) A refinement which consists in a pavement sloping upward toward the choir, nearly always with arches and capitals brought down to the horizontal level, and sometimes with capitals and arches brought below the horizontal level. The effect in either case is one of perspective illusion. I can specify eighty-five cases of this phenomenon for Italian churches. The slope varies from three or four inches to over three feet. The church of Santa Maria Ara Coeli at Rome, the Capella Palatina at Palermo, the Cathedrals of Siena and Orvieto are among this list. This phenomenon has been overlooked by all publications up to date, as far as known to

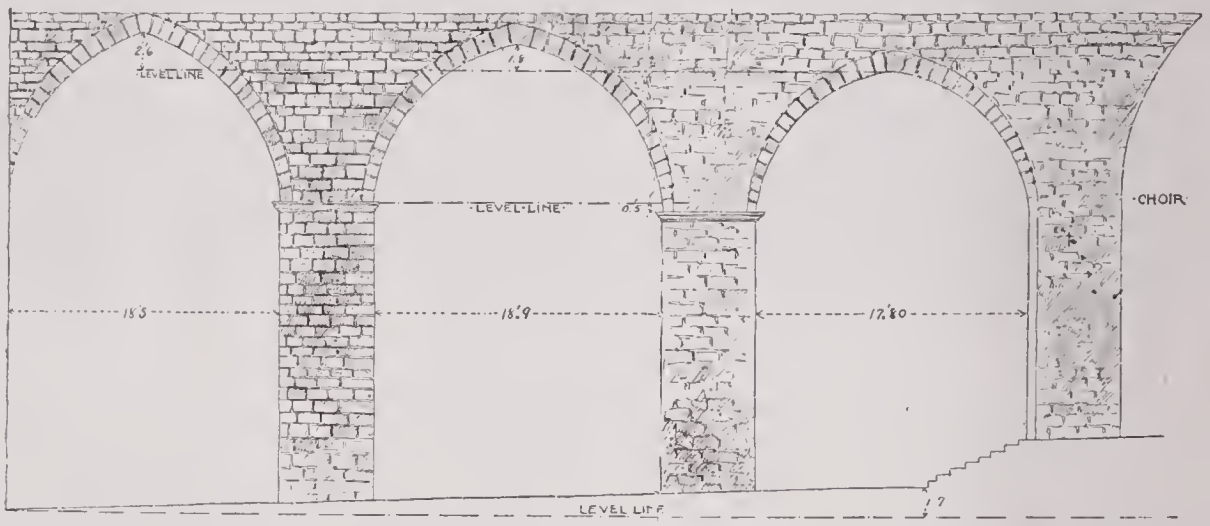

FIG. 7.—SAN PIETRO AT ASSISI.

Section showing a drop in arches of 2.60 (feet and decimals) and pavement rising 1.70. Survey and drawing by John W. McKecknie for Brooklyn Institute Survey.

another list of churches in which the span narrows in the choir *away* from the dome or the transept arch.

(*j*.) A refinement analogous to the last but applied to the second of the two transverse arches which span the nave of a church at the junction with the transept. By dropping this second arch below the level of the first a considerable increase of perspective is obtained. There are good cases of this scheme in the Cathedrals of Siena (drop of five feet), Piacenza (drop of four feet), and Pisa (drop of three feet), and in Santa Maria Novella at Florence (drop of two feet). There are no extant publications of these facts.

me. I can specify many interesting cases of oversight on the part of persons known to me of this peculiarity. There is no reason why it should not be noticed by tourists for pleasure as easily as by experts, but it seems to have escaped the notice of both classes. This fact is quoted for the Egyptian temples, and in them is supposed by Egyptologists to have the purpose of perspective illusion. The evidence to be submitted tends to show early Christian and Byzantine origin, as usual in all these refinements. The sloping pavement can be dated to the fifth century in San Sabina, at Rome.

(*l*) A refinement which consists in

converging the walls of the church or the piers and walls of the nave in the direction of the choir. (Fig. 8.) Five cases are known to me in Italy. None have been previously noted by publication for Italy, but one case is already known by publication for Northern Europe. It is the Cathedral at Poitiers mentioned by Fergusson. The maximum case of convergence is in San Stefano at Venice, whose walls narrow in toward the choir twenty-three feet in a length of one hundred and thirty-three feet.

(*m*) A refinement which consists in building the church with an oblique or twisted plan, so regulated as to mystify the eye as to the proportions of the building and without revealing itself as an obtrusive fact. Of all the phenomena quoted the one of a deflected choir is the only one so far known to science. There is no evidence in Northern Europe to support the view that a deflected choir represents the bending of the head of Christ on the Cross. On this point of lack of evidence see *Notes and Queries*. The idea that a deflected choir represents the bending of the head of Christ on the Cross may be a fancy of modern sentiment, or it may be a tradition springing from the explanation of some mediæval builder who found it inconvenient to give his true reason. The evidence which I have collected in Italy antagonizes this explanation, because there is no trace of this tradition in Italy, because the phenomenon appears in many churches which have no transept and which consequently do not represent the Cross (see Fig. 9), because there are cases in which there is no bend or deflection of the plan, but only an obliquity of the whole plan, and other cases where there is obliquity and where one side of the church is longer than the other, but no bending of the choir, and because these cases merge into others which simply show the curve in plan of columns or clerestory walls (one or both), which is the earliest dated phase (sixth century at Ravenna). In other words, the deflected choir of Northern Europe is only one phase of a wider fact, which no doubt also has many Northern illustrations (some of which are already known to me). I have collected thirty-six cases of these curious plans in Italy, and many of them have been carefully surveyed. Good instances are found at Arezzo, Bari, Toscanella, Viterbo, Cremona, etc. Nearly all are oblique from the façade as distinct from churches with a deflected choir.

(*n*) There are many phenomena which are most easily classed under the general heading of symmetrophobia, or dislike of mathematical symmetry. This designation has the advantage of avoiding optical theories or optical explanations, and may be applied to many facts already cited under foregoing heads if other explanations offered, or to be offered, should not satisfy the reader. This designation may be applied, for instance, to the oblique or twisted ground plans by any one wishing to preserve an agnostic attitude as to explanations of curious facts. Mr. Ruskin's conception of "life" in mediæval building is preferable to the conception carried by the term "symmetrophobia," which implies a negative attitude on the part of the mediæval builder, whereas all the motives which tended to give variety to a building by discarding symmetry tend also to this effect of "life." Some cases, like the bent column at Arezzo (Fig. 10), seem to be pure symmetrophobia. As I have a long list of phenomena for later description, which have not been cited by Mr. Ruskin, and which do not come under any of the classes so far mentioned, we will use the word "symmetrophobia" provisionally to designate them. This word, by the way, is not one of my own coinage, as has been supposed by some. It has long been applied to the irregular features of Egyptian temples (for example, at Philae), and originated in Egyptology or with persons interested in it.

IV.

The foregoing schedule, in spite of its length, is wholly tentative and preliminary. It is a condensed statement needing much elaboration and

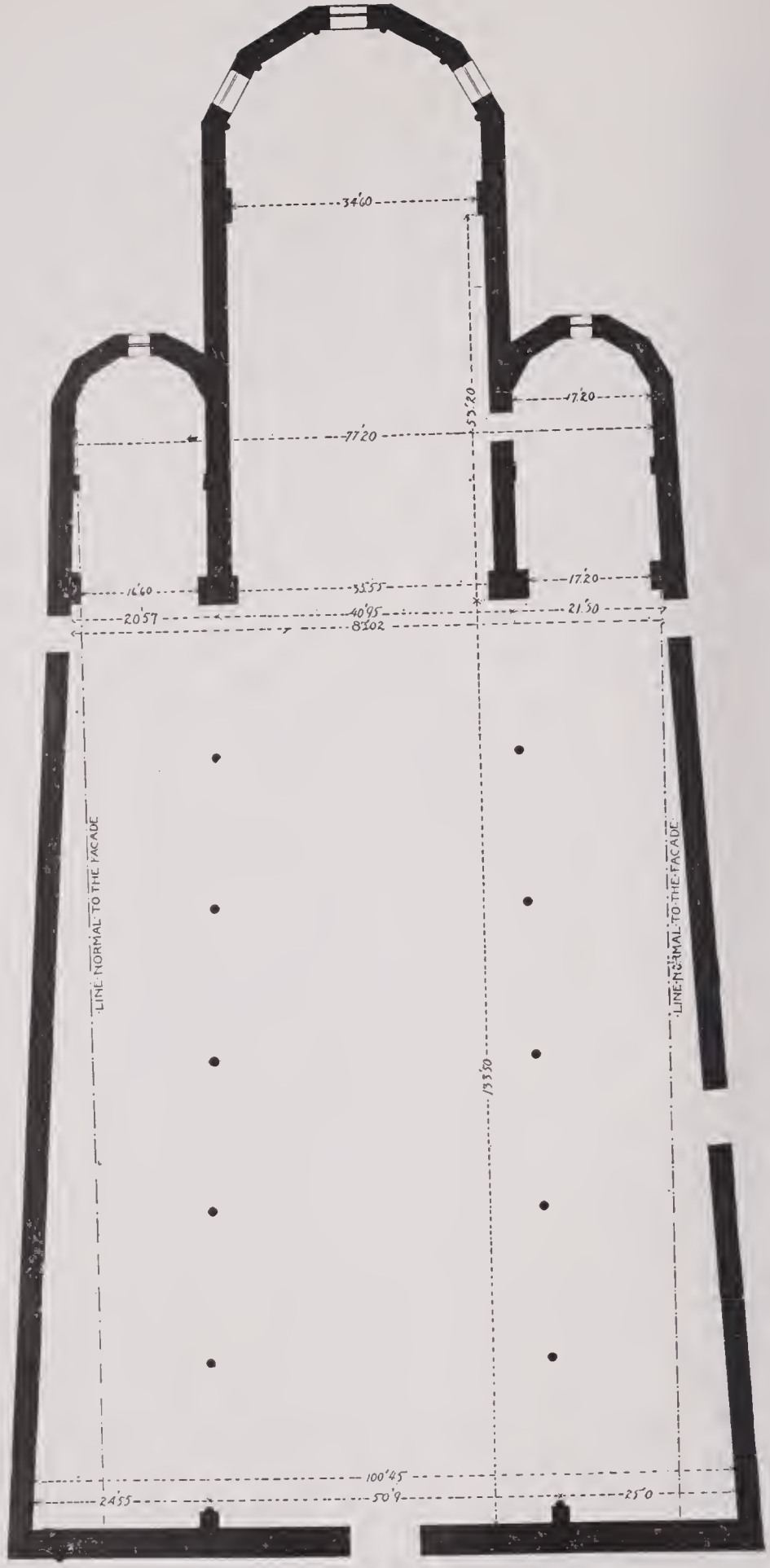

FIG. 8.—GROUND-PLAN OF SAN STEFANO AT VENICE.

The walls narrow in 23 feet in 133 feet. The nave narrows in 16 feet. Survey and plan by John W. McKecknie for Brooklyn Institute Survey.

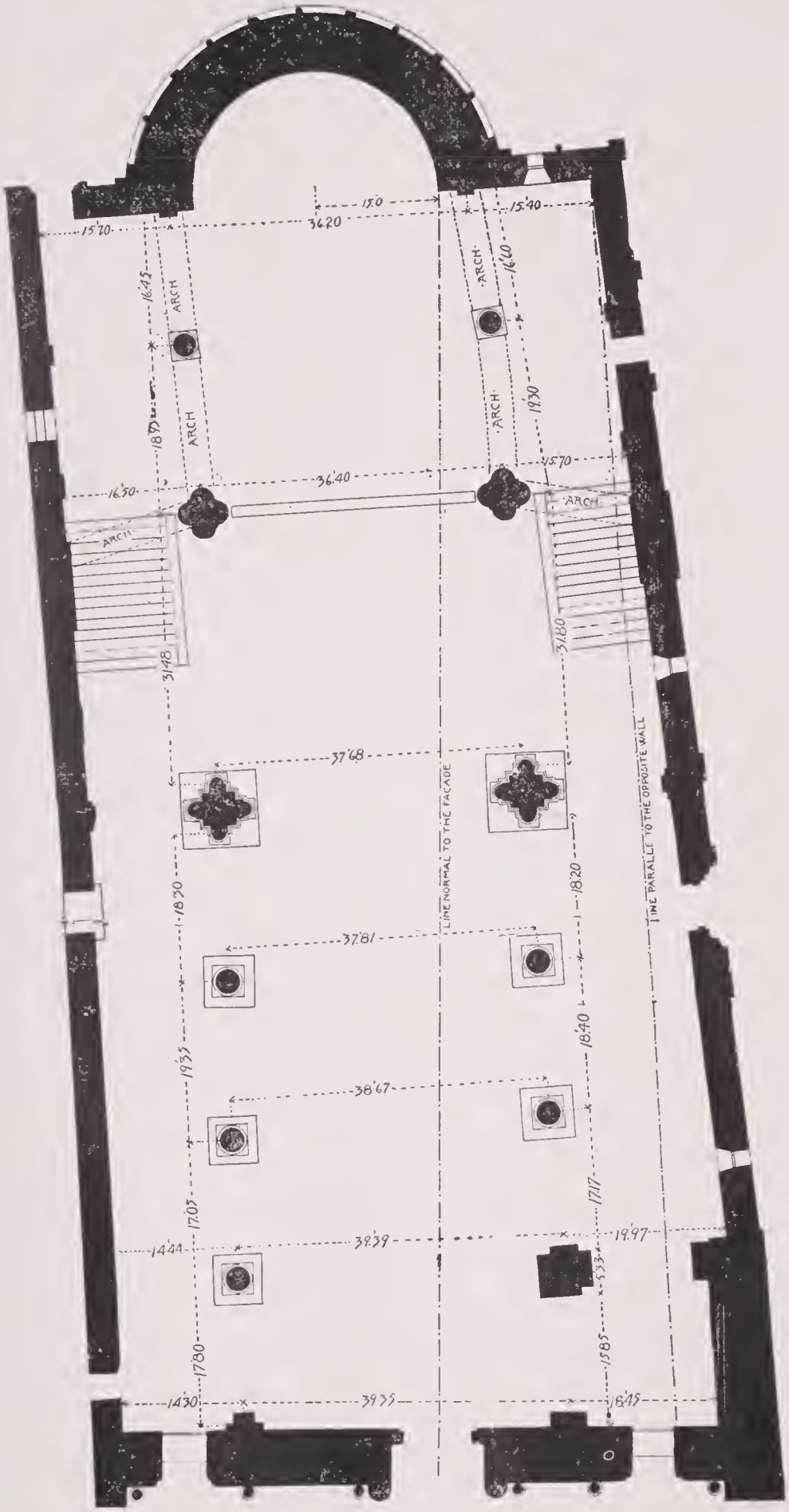

FIG. 9.—GROUND-PLAN OF SANTA MARIA DELLA PIEVE AT AREZZO.

Survey and plan by John W. McKecknie for Brooklyn Institute Survey. The church is deflected 15 feet from the normal line.

development, and is a mere hint of the actual facts, which have to be specified for about one hundred and thirty-three churches, many of which need careful description and all of which need very abundant explanations in rebuttal of suggestions of accident, carelessness, indifference and the like.

This schedule is, however, sufficiently definite and explicit to permit of my announcing the general main fact of what I conceive to be an epoch-making discovery in the study of mediæval architecture. As distinct from views hitherto held by the most enthusiastic students of the Middle Ages, I shall be able to prove that, apart from the beautiful variations of detail due to artisan skill, and apart from the picturesque effects of general organism due to a noble contempt for mechanical regularity, there was in mediæval building a definite system of optical and perspective illusion very largely, but not universally, practiced —a definite system of very subtle calculation of optical effects—a definite system of *masonry refinements*—and a definite system of survivals of some of the most remarkable architectural refinements of classic antiquity. I shall be able to prove, moreover, that the facts, in so far as they are made manifest for Northern Europe, move from Italian influence; that in Italy they move from the Italo-Byzantine centres, and that the facts are most numerous for the period and buildings of the Byzantine-Romanesque. Dates are established for the curves, the sloping pavements and the converging walls which carry them back to the earliest extant buildings of Christian architecture.

The germ of these discoveries goes back to measurements which I made at Pisa in 1870, and which were published in *Scribner's Magazine* for August, 1874, under the title of "A Lost Art."

I claim that the study of mediæval architecture stands to-day where that of the Greek temples stood before the discoveries of the Greek architectural refinements by Pennethorne, Hoffer and Penrose. It is well known that all the studies of mediæval architecture lie wholly within the limits of our own century and that they date mainly after 1825 or later, whereas those of the Greek temples date from the middle of the eighteenth century. I have shown in THE RECORD article already quoted that the Parthenon had been surveyed and carefully examined during nearly a century, before the discovery of its curves, leaning faces, irregular spacings, and other optical refinements, which were first published by Penrose in 1851. The beginning of the study of mediæval cathedrals is, as a matter of fact, fully seventy-five years later than the beginning of the study of Greek temples; and if, in the last years of the nineteenth century, we are still ignorant of some of the most interesting traits of many important cathedrals, we are only repeating the experience of history that discoveries come gradually, and that the wisdom of all the ages has not been conquered in a day.

That the attainments of past ages have been forgotten and lost sight of and have had to be rediscovered is no unfamiliar thing. A most telling instance is that of the Greek refinements just cited whose existence had disappeared from the memory and apparently from the records of man until once more brought to light in the nineteenth century.

The success of the Survey in Italy was much indebted to the favorable disposition of the Italian Ministry of Public Instruction, as represented by Signor Ricchiardi. I obtained from him the extraordinary favor of a *carte blanche* permit to take measures and photographs in church interiors throughout the country, and to photograph in all Government museums. For this concession I have to be grateful, in the first instance, to the influence of the Smithsonian Institution, as represented by Professors Langley and Goode.

Wm. H. Goodyear.

(To be Continued.)

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

DEPARTMENT OF FINE ARTS

ILLUSTRATED CATALOGUE

OF THE

Goodyear Collection of Photographs

OF

ITALIAN ARCHITECTURE AND SCULPTURE, AND OF THE SURVEY OF ITALIAN MEDIÆVAL BUILDINGS.

The Original Observations, Choice of Subjects and Catalogue Text by
PROFESSOR WM. H. GOODYEAR.

The Negatives, Prints, Bromide Enlargements, and Cartoons of the Survey by
MR. JOHN W. MCKECKNIE.

BROOKLYN:
EAGLE BOOK AND JOB PRINTING DEPARTMENT.
1896.

CATALOGUE

OF THE

GOODYEAR COLLECTION.

Part I. of this Catalogue consists of advance sheets from the July number of the Architectural Record Quarterly Magazine, supplied through the courtesy of the Editor, Mr. Henry W. Desmond.

Part II. of this Catalogue consists of a prefatory account of the Brooklyn Institute Survey of Mediæval Italian Buildings, carried out May–October, inclusive, 1895, and of the classes of artistic and archæologic subjects photographed in Italy for the Institute Collections.

Part III. of this Catalogue specifies the groups and individual numbers of the photographs and of the cartoons of the Survey.

Very special acknowledgments are due to the Smithsonian Institution, as represented by its chief, Prof. Langley, and by Professor G. Brown Goode, Director of the National Museum, for letters under seal of the Smithsonian Institution to the Italian Ministry of Public Instruction, which secured the favor of a *carte blanche* photographing permit in all the Museums and churches of Italy. This privilege has been recently refused to the application of the American Embassy, as the government rule requires special application to each local authority.

PATRONS OF THE BROOKLYN INSTITUTE SURVEYING AND PHOTOGRAPHING EXPEDITION TO ITALY.

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PREFACE.

An arrangement was made in the Spring of 1895 between the Brooklyn Institute of Arts and Sciences and Professor Goodyear, according to which the latter undertook to pay his own expenses in Italy for a period of five months, and to give the Institute the benefit of his time and experience in the matter of selecting photographic subjects for its future collections. The Institute undertook to pay the expenses of a scientific photographer and surveyor in the person of Mr. John W. McKecknie, and was to own all negatives taken, up to the number of 600, to have credit for all use made of the same in the way of publication or otherwise, and to have credit for supporting a survey of mediæval Italian buildings.

One purpose of the expedition was to photograph any artistic or archæologic subjects whose rarity, beauty, unusual value, or educational importance seemed to make them worthy of selection. In the original 8 x 10 negatives the choice of the artistic and archæologic subjects was generally directed by the advisability of avoiding those which are already either familiar to tourists in Italy, or in any way obtainable by purchase there ; excepting in cases where the effort has been to make a series whose educational value consists in a completeness not hitherto achieved or attempted. This latter point of view applies to the sets from the Naples Museum and from the Baths of Pompeii, and will be best appreciated by examining the 8x10 prints, which are three times as numerous as the bromide enlargements.

In the choice of mediæval architectural subjects the effort has been to photograph fine details from localities which are rarely visited, such as Troja and Toscanella, or to obtain negatives available for enlargement of fine details from better known localities, such as Lucca. In so far as either the exteriors or interiors of entire buildings are concerned, there are many photographs from buildings already accessible to photography, but there are none from such buildings which are not taken either from fresh points of view or under conditions of scientific accuracy never heretofore attempted for Italian buildings. All these last-mentioned photographs relate in one way or another to the interesting subject of irregularities and masonry "refinements" in mediæval architecture, a subject which has never heretofore been systematically and scientifically examined, and which it was the purpose of the Survey to bring before the public. Many of the most important and remarkable pictures devoted to this topic are confined to the 8x10 prints. The choice of bromide enlargements has been largely controlled by the perfection of the negative and the attractive or popular interest of the subject.

The cartoons of the Survey represent only a small part of the labors and results of the expedition in the matter of surveys and measurements, and these will be matter for future publication.

All cartoons and photographs have been personally made by Mr. John W. McKecknie. With rare exceptions no photographs are exhibited which were not personally made by him. In five or six cases negatives were made in Italy after the termination of Mr. McKecknie's stay in Italy, Prof. Goodyear having remained a month longer to complete the Survey. The following list specifies the groups and classes of subjects.

The views from the Naples Museum belong to a class already familiar to photography, but there has hitherto been no attempt to include *all* the galleries of the Naples Museum in one series in such a way that the extent and character of *all* its collections may be understood at once by those who have not enjoyed the opportunity to visit Naples. The enlargements from this set are chosen on account of their rare photographic perfection.

Another series is wholly unique. Not more than three or four views of the Baths of Pompeii are obtainable in the shops of Naples. It appeared desirable to give a complete and connected view of *all* the apartments in the Baths of the Forum and of Stabiae. Hence a series of pictures, of which only three or four are taken in those parts of these Baths which have been chosen for views by other photographers. None of these are represented by enlargements.

There are no detail photographs for sale in Italy of the stucco decorations of Pompeii, and such details have therefore presumably never been photographed before. The collection contains a set of 8x10, from which we offer several enlargements. The beauty and novelty of these details will speak for themselves. They are not works of famous artists but were made by the day-laborers and ordinary artists of Pompeii.

Another series of charming stucco relief had never been photographed in details up to the time of our 1895 visit to Italy. We learned in Rome that it was under consideration to have them photographed, but the set here exhibited is the first one ever made. It is wholly from the decorations found in recent excavations on the grounds of the Farnesina Villa at Rome, now in the Museum of the Baths of Diocletian. Most of these are shown by enlargements.

The photographs from the Greek ruins of Pæstum and of Sicily are the first ones ever taken of the given buildings to show the Greek architectural refinement of curving the horizontal lines of their temples. So far, the only photographs of the Greek curves are those taken by Mr. Stillman, at Athens, some years ago.

The subjects from the Etruscan Museums of Perugia and Chiusi *are all new to photography*. It will appear surprising that these photographs are not obtainable in Perugia when the artistic beauty of the originals is considered, but Italy is rich in neglected treasures and these have been among them. The photographs from the Etruscan Museum of Volterra are almost wholly from subjects not hitherto taken. There are many rare subjects from the three Etruscan Museums named which are confined to the 8x10 series and not represented by enlargements.

There is at present only one series of photographs obtainable in Italy for the territory of Lucania and S. E. Italy. This Italian series *does not include* the capitals from Ruvo and Troja. The latter are the finest work of the kind known to the writer from all mediæval Italy. As survivals and continuations

of classic quality in mediæval art the capitals from Troja are wholly unrivalled. One of these capitals would be pronounced by every expert to be an ancient classic piece were it not for the equally fine work in its two fellows, which have unmistakable mediæval peculiarities. The bronze doors of the Troja Cathedral are unrivalled in all mediæval Europe. The details from Bari are also remarkable.

The series of photographs from Toscanella is of rare interest. Toscanella is about three hours' carriage ride from Viterbo, and is rarely visited. The façade of San Pietro, at Toscanella, is one of the most remarkable in Italy. The details from this façade are the first ever taken, and are not obtainable in the only Italian series which includes Toscanella.

From a passing mention of the fine architectural details of the façades of San Michele and San Martino, at Lucca, we turn to the photographs illustrating architectural refinements, and the cartoons of the Survey connected with them, which are best explained by the advance sheets of an article from the Architectural Record Quarterly Magazine, which are bound up with the catalogue, and by the notes connected with the individual numbers. Some account of the arrangements ensuring absolute accuracy in these photographs is, however, important.

Mr. McKecknie's preparations for the trip included, besides the usual paraphernalia of the architectural surveyor, a camera designed to secure absolutely mathematical accuracy in the photographs to be made of architectural phenomena. Some of its peculiarities were especially designed by him, and it is believed that some of them have never before been applied to scientific photography. The ordinary photograph often represents the interior of a Cathedral with the rising lines distorted by tilting the plate. Diverging, or spreading, or curved lines, in the piers of the nave, are under such circumstances not correctly represented, by the photograph. As it was our purpose to test churches for this peculiarity, a camera was procured with an unusually long "swing-back," for keeping the plate vertical in reaching to high altitudes. It was also provided with a level and compass. The compass was intended to secure the taking of photographs in absolutely true parallel perspective, which in the case of horizontal curves or other masonry obliquities is essential to proper accuracy of illustration. In the photographs designed to represent masonry distortions having an optical effect, it was of course necessary to eliminate not only all the distortions usually found in photographs, but also those due to perspective. The level made it feasible to test by photography, as well as by the eye or by plumb, all deviations from the perpendicular line. The lenses were specially selected for absolutely rectilinear accuracy.

PHOTOGRAPHS AND CARTOONS ILLUSTRATING MEDIÆVAL OPTICAL REFINEMENTS.

It is not, generally speaking, the mission of this catalogue to give reasons explaining the architectural phenomena illustrated, although they may be suggested in some cases. Reference is made on this head to an article published

in Scribner's Magazine for August, 1874, entitled "A Lost Art," to an article in the "Architectural Record" for April, 1895, on the "Origin of Greek Curves" and to the article bound in with this catalogue.

There is, however, one important caution to be noted by students of these photographs and cartoons. They relate to the originals as a Muybridge photograph of a running horse or a walking man relates to our apparent perception or vision of this motion. We do not see the horse run as the Muybridge photograph proves that he really runs. Neither do we see these buildings as these photographs prove them to be made. A photograph fixes immovably an obliquity, curve, or irregularity from one given point of view, whereas the eye is constantly in motion and insensibly or unconsciously translating these irregularities into optical effects of various descriptions.

VERTICAL CURVES AND VERTICAL LEANS.

1 Photograph of the bend or curving line found in the transept piers of the Pisa Cathedral. A line hanging by a stick from the gallery shows the delicacy of this curve, which has a deflection of only three and one-fourth inches. This is the first photograph ever taken especially to illustrate the fact of this refinement, which is, however, a frequent appearance in Mediæval cathedrals. When hitherto noticed this bend has been attributed to thrust. Proofs to the contrary are now forthcoming, and are especially strong in the Cathedral of Piacenza, where this curve occurs in piers facing solid walls twenty feet deep. Mediæval churches having this curve in the piers are numerous in Northern Europe, as well as in Italy. Among the Italian instances are the Cathedrals of Pavia, Cremona and Siena and the church of San Ambrogio at Milan.

1a The same piers and their curving line shown by a view taken from the top of the High Altar. The Baptistery is seen through the open door.

2 Interior of the Cathedral of Cremona showing a similar bend in the piers.

3 Photograph from the Cathedral of Fiesole. The survival of the classic entasis in Mediæval architecture is seen in the half-column facing the pier. In spite of the inferior quality of the photograph it is one of the most important and represents the *first publication* of the generally unknown fact of this survival. The curving pier, as seen at Pisa, is probably derived from such an entasis.

4 Cathedral of Perugia—a case of the spreading piers–(piers leaned backward from the nave) occasionally found in Mediæval architecture. A phenomenon so far ascribed to thrust, in so far as observed. The following cases and several others are verified by the Survey as not due to thrust.

5 St. Mark's at Venice. Showing a spread in the piers (piers leaned outward in the nave) verified by the Survey as not due to thrust. The individual leans are over a foot deflection from the vertical.

6 Santa Maria della Pieve, Arezzo, showing a spread, or outward lean, in the piers, each leaning over a foot. Verified by the Survey as not due to thrust. Also so recognized by the local experts of Arezzo.

7 Cathedral of Trani, showing a spread of the piers at the transept, verified as not due to thrust.

8 Drawing of the interior of San Stefano at Bologna, showing a spread of walls and piers, verified as not due to thrust. 9 Photograph of same.

10 Leaning façade of the Cathedral of Ferrara. Among other important cases are San Michele at Pavia, San Ambrogio at Milan and the Cathedral of Pisa. These leans bend back toward the vertical, are similar to the bends of No. 1, and are frequently as delicate; for instance, in San Nicolo at Bari. Proofs for constructive intent are supplied from San Michele at Pavia and from Pisa. The lean at Ferrara is estimated by the Survey at about nine inches.

11, 12 South and north walls of the Pisa Cathedral, showing deflected masonry stripes bent down at the fifth bay and yet entering the façade piers at a right angle. Thus, the obtuse angle of stripes at the fifth bay measures the forward lean of the façade. The direction of the stripes, as bent at the fifth bay, proves that if the façade leans as a result of settlement, the settlement must have begun as far back as the fifth bay, and must have included the whole front part of the building on both sides as far back as this bay. Examination of the masonry of these bays over the stripes, and measurements taken to its different features, such as main cornice, pilaster capitals and arcades, show that their irregularities are not due to settlement, for the cornice rises and the arcades drop downward. The pilaster capitals drop downward, but more abruptly than the arcades, while both the arcades and the capitals drop down at angles differing from those of the stripes. The resulting conclusion is inevitable, that all these irregularities are due to masonry construction. Moreover, if the front of the building settled, it must be conceded from the cornice measurements that the settlement ceased before the cornice was reached by the masons. If so, all the original plinth masonry of the façade must have sunk into the earth 8 to 15 inches before the first cornice was reached by the masons, and if so, all this masonry must have been taken out and replaced by the present masonry of the plinth line and base courses to the extent of 8 to 15 inches; but when a survey is made of the irregularities of the façade itself, we find another series of irregularities as regards the height of the columns and main cornice. These are fourteen inches wider apart at the south angle than at the north angle. Hence we are obliged, on the theory of settlement and masonry substitution, to formulate a new series of theories of lateral settlement, and these are found to contradict the theories as to settlement at the angles, which would be made necessary by the measurements of the side walls. In other words, all the obliquities and leans must be considered together, as all related to settlement, or as all existing in masonry construction. When so considered, masonry construction will demonstrate itself, and the settlement theory will shipwreck itself.

13 Pisa Cathedral façade, photographed in parallel perspective, to show its lateral irregularities. The first cornice rises 7 inches to the south and the capitals drop 7 inches to the south, as measured to the pavement.

Still another argument is obtained as to these lateral irregularities from the levels taken on the first main string-course of the façade and on the interior gallery on the same level and forming part of the same wall. These levels prove that if the façade settled laterally, there were two settlements in contrary directions at one and the same time, which is absurd. The pavement itself slopes down ten inches to the south.

We have thus reached the conclusion that the entire front of one Mediæval building was purposely built out of the vertical line. This is the most important observation ever made on the subject of leaning buildings in Italy, and recalls the direction of Vitruvius regarding the façades of ancient temples that they should be inclined forward from the perpendicular. It must be remembered that this lean bends or curves back to the vertical. The maximum lean amounts to about 15 inches. **13a** shows the lean at S. W. angle.

14, 15 Photographic details from the S. W. and N. W. angles of the Pisa façade to allow inspection of the masonry. The fresh masonry of the fifth bay of the south wall is revealed by the color. This dates from a recent repair and does not affect the question of settlement. The only possible theory of settlement must assume settlement before the first cornice was reached and consequently must assume an ancient repair of the masonry as old as the building itself. Appeals to modern masonry repair have therefore no point. The foundations at the N. W. façade angle are intact ancient masonry as old as the building (see No. 15.) This establishes the ancient plinth line, which is elsewhere modern repair all around the building, but only for the first two or three courses.

16, 17 Sketch of the façade masonry from San Michele at Pavia, showing facts similar to those which hold for the Pisa façade. The cutting of the individual masonry blocks proves a constructed lean. By plumb this amounts to about eleven inches.

18 The Baptistery of Pisa, photographed to show its lean toward the northeast. Taken from an upper gallery of the cathedral.

19 Survey and levels for the foundations of the Pisa Baptistery, proving a lean by constructive intent. Original survey made in 1870, verified in 1887, and still more accurately verified by levels in 1895.

20 Sketch of the Torre del Publico at Ravenna, showing a constructed lean.

21 Masonry courses of the Bargello Tower at Florence, showing a constructed lean.

22 The Leaning Tower of Pisa. The foregoing numbers, 4–20 inclusive, are important circumstantial evidence for the constructed lean of this Tower. As is well known it has long been a debated point whether the Leaning Tower of Pisa is a constructive or accidental fact. The Tower also curves back toward the vertical (this is best seen from a more westerly point of view). This seems to explain the story dating from Vasari's *Lives of the Artists* (16th cent.), that the Tower gradually sank and was gradually built up to the vertical during its construction. A more improbable story was never invented; if the interest of the masons in their own lives be considered. It is certain, however, that the Tower settled, if at all, during construction and not afterward. This photo-

graph is the first one ever taken to show the well in which the Tower stands, and was made by Mr. McKecknie on a ledge about three feet wide on the upper exterior gallery of the cathedral choir.

It must be noted that two towers in Bologna are already conceded to lean by construction.

The numbers 1–22, inclusive, all relate to inclinations, or deflections, of vertical lines from a true perpendicular. It is a tentative conclusion of the anthor of the Catalogue that the more extreme cases, like the Leaning Tower of Pisa, are later evolutions and exaggerations of a much more delicate system of leans and bends prevalent in Italo-Byzantine building, such as No. 1, of which many additional examples can be given outside the limits of this catalogue. These more delicate leans and bends were certainly masonry refinements, dictated either by picturesque considerations, or by optical considerations, or by both. The fact that they have direct analogies in the Greek temples, whose purpose is still a matter of doubt, and in the directions of Vitruvius, whose purpose is also in doubt, leaves us free to present the facts to the world, without pretending to offer full explanation. The probability may, however, be considered fairly established that the more pronounced leans, like that of the Tower of Pisa, owe their existence either to caprice, or to a seeking for renown or fame by *a tour de force*, or to a very highly developed sentiment for the picturesque which has other remarkable phases of asymmetry. See for instance the crooked column of Arezzo, No. 172.

23 Cathedral of Pisa, view showing the outward lean of the choir. Plumbed from the upper gallery it leans out fifteen inches, with a returning bend toward the perpendicular.

24 Choir of the Pisa Cathedral, in parallel perspective.

OBLIQUE HORIZONTAL LINES AND OPTICAL MYSTIFICATIONS IN SCHEMES OF SPACING.

25 Survey of the south wall of the Pisa Cathedral, showing the measurements for the obliquity of the lower cornice, which is about two feet out of horizontal, dropping toward the transept. See also the plan with levels No. 28. This feature gives a direct perspective increment from many points of view and optical mystification from others. Compare the photographs 11, 12, 14, 15.

26 Transepts of the Pisa Cathedral showing the drop of the cornices.

27 Survey of the north wall, Pisa Cathedral; similar facts.

28 Ground-plan of the Pisa Cathedral showing levels of the central cornice and of the earth's surface all around the building. This cornice drops continuously from façade to choir. The ground-plan also shows the intercolumnar spacings of the interior and the spacings of the exterior arcades. In both lines of nave columns there is an increase of width from the façade up to the fourth bay, and a decrease in the following

bays. On both exterior walls the first five bays, beginning with the façade, are much wider than the following bays, and on both sides the bay next the transept is much wider than the one adjacent. These correspondences show a design underlying the irregular construction, either of an intentional avoidance of regularity for picturesque effect, or of an optical illusion, or a mixture of the two designs.

29 San Paolo Ripa d'Arno, Pisa. General view, showing the oblique plinth line of the north side wall.

30 View in parallel perspective of the oblique plinth line of San Paolo Ripa d'Arno. (This photograph also shows a rising curve in the cornice, which is an optical effect of the curve in plan. See No. 132.)

31 Survey of the oblique plinth line of San Paolo Ripa d'Arno, with levels of the surface and of the plinth. In the direction toward the transept the arches rise 1 ft. 20, as measured to the plinth, the plinth drops 2.40, and the earth's surface drops 1.01. If the plinth settled, the arcades must have been originally 2.67 above level at transept, with a rising obliquity of that amount, as compared with arcades near the façade. In other words, a theory of settlement obliges the sceptic to account for another obliquity more remarkable than the one he is trying to prove accidental. The remarkable case of asymmetry thus established has many analogies. The optical illusion which it creates is so remarkable that the surveyor could not believe in the accuracy of his level, and procured a new one at considerable expense to test the facts. One of the illusions produced is that the earth's surface rises when it really drops.

32 Cathedral of Troja.

33 Survey of the south wall of Troja Cathedral; showng a plinth line built to a level, an aisle roof line built obliquely (dropping from façade to choir), a scheme of arcade spacings, increasing toward the choir in span and height, and a scheme of pilaster capitals decreasing in height in the same direction. This scheme of mystification is not detected by the eye, and is only made apparent by a survey. See Nos. 243–250 for views and details from Troja.

34 Side wall of the Prato Cathedral having a similar scheme as regards the arches and the capitals. Arch span increases from façade to choir (as far as the door). Capitals drop in the same direction.

35 Side of San Michele at Lucca, in parallel perspective. Gallery arches narrow toward the choir. The columns have an entasis. There is a scheme in the spacings. See next No.

36 Survey of the opposite side of San Michele at Lucca, showing the oblique and curved plinth line. Scheme of pilaster spacings, moving from the centre toward the angles (with one break in the scheme). Same scheme is found in 35.

For photograph sighting on the curve of this plinth line and its masonry courses see No. 158.

37 Photograph of one side wall of the church known as the Pieve Nuova, at Santa Maria del Giudice, near Lucca, viewed down the incline.

38 The same, seen up the incline. This is the most remarkable case in Italy

of building a plinth line to the earth's surface, and is distinct from preceding cases.

39 Detail of the masonry of this wall taken with a plumb-line.

40 Survey of this wall, showing a cornice line exactly level. (This speaks for the accuracy of the builders, wherever an effort to be accurate was made.) A curving scheme in pilaster capitals, and remarkable variations of pilaster spacing.

41 Façade of this church, showing accurate spacing of the arches each side of the door as regards dimension of corresponding arches. This argues intention for variations in the side spacings, as it proves capacity for accuracy.

42 Photograph of the other side of this church.

43 Survey of this wall, showing a cornice line exactly level, a method of building to surface which differs from the other side, and remarkable irregularities or schemes in spacings and heights of capitals.

OPTICAL ILLUSIONS IN CHURCH INTERIORS.

The facts which follow are important as proving conclusively that certain kinds of optical deception were practiced in the Middle Ages. These facts are hitherto unrecognized. They react on our view of possible causes for the more subtle or less easily understood irregularities hitherto considered.

The arrangements to be illustrated are calculated to increase the perspective effect of a church as viewed from the main entrance and looking in the direction of the choir. The large dimension of the first, second, or third bay will be generally taken as standard for the size of the more remote bays which have a smaller span. The schemes which are least easily detected and most effective, generally begin at the second or third bay. In still larger churches, like the Pisa Cathedral, the fourth bay from the entrance is the largest. In such cases the curve of the line of arches rising from the entrance and then dropping toward the choir is equally contributory to perspective effect and less easily detected than a uniform downward slant.

44 Façade of the church known as the Pieve Vecchia, at Santa Maria del Giudice, near Lucca.

45 Survey of a section of this church.

46 One bay of this church, showing the drop of the right capital.

47 The interior of this church, showing how the perspective effect of above arrangements is discounted by the eye into a natural effect.

48 Survey of San Pietro Somaldi, at Lucca. Arches drop toward the choir. The last bay again rises, and widens in span, as required for the greater space devoted to the choir.

49 Interior of the above church with illusive effect discounted into perspective.

50 Survey of Santa Maria Bianca, at Lucca. Compare arches left and right of the pier. They drop toward the choir.

51 Interior of the above church, showing the drop in arches.

52 Survey of San Frediano, at Lucca, showing a delicate drop in the arches and capitals, and a successive stepping-up in the levels of the pavement, both contributory to perspective effect.

53, 54 Interiors of this church.

55 Photograph in parallel perspective of San Stefano outside the walls, at Pisa. The scheme here is too abrupt for subtlety, and represents the trick of a village builder. This is the most obvious scheme in Europe. It is known that in the eighteenth century the church was entered at the end near the smallest arch, but the present façade is ancient, and has all indications of having been the ancient façade of the church.

56 Interior of the above church, which discounts the arches, as seen in 55, into perspective effect.

57 Survey of the above church.

58-59 Interiors of San Frediano at Pisa.

60 Survey of San Frediano at Pisa, showing a much more subtle scheme similar to the foregoing.

61 Nave of the Pisa Cathedral, looking toward the choir. In this view the drop of the arches on both sides, away from the entrance, may be detected by close inspection.

See the ground-plan of the Pisa cathedral (No. 28), for the scheme of intercolumnar spacings, and the surveys of the gallery levels for the drops in line of arches (Nos. 62, 63).

62 Survey of the north gallery levels, Pisa Cathedral.

63 Survey of the south gallery levels, Pisa Cathedral.

64 Survey of San Michele ai Scalzi at Pisa, showing a scheme in the interior similar to that of Troja exterior, No. 29.

65 Plan of the Cathedral at Prato, showing a scheme in the span of the interior bays, and also showing the scheme of exterior arcade spacings (See No. 34).

66 Interior of Santa Maria Novella at Florence. View which discounts the scheme of illusion.

67 Separate bays of Santa Maria Novella, placed side by side to betray the scheme of illusion. The maximum diminution of pier spacings in this church amounts to thirteen feet.

68 Section of Santa Maria Novella at Florence, showing scheme in spacings.

69 Section of Cathedral of Fiesole, showing the scheme in spacings and drop in arches toward the choir.

70 Interior of the Cathedral of Fiesole, taken from a point discounting the illusion.

71 Interior of Cathedral of Fiesole, taken so as to betray the illusion.

72 San Stefano at Bologna. Survey of the scheme in arches and drop in capitals.

73 Photograph of the same.

74 Plan of the Cathedral of Arezzo, showing a scheme in the spacings.

75 Section of the Church of San Nicolo at Bari, showing a bend in the line of arches spanning the nave, and a drop in the arches of the nave (also in the clerestory.

76 Series of Photographs of San Nicolo at Bari, in parallel perspective, showing drops in the arches in the direction toward the choir.

77 Nave of the Siena Cathedral, showing the first arch as three feet higher than the following ones. The surveying party spent two days in the church before this fact was noticed. It appears very obvious *after it is noticed.*

78 Dome of the Siena Cathedral. Photographic detection of the trick by which the second transverse arch supporting the dome drops five feet lower than the first arch of the pair. Compare No. 78A.

79 Photographic detection of the same trick in Maria Novella, at Florence (drop of about two feet.) The view is taken across the nave and the arches to be compared are those to left and right, spanning the nave.

80 Photographic illustration of the same trick in the Pisa Cathedral. The first transept arch is pointed, the second is round (drop about three feet.)

81 View of the Cathedral of Piacenza, in which the same trick occurs (drop about four feet.)

82 Survey of San Michele, at Pavia, showing a drop in the arches, toward the choir (nave and clerestory.)

83 Survey of San Ambrogio, at Milan, showing a drop in the arches toward the choir.

84 Survey of cathedral of Borgo San Donnino near Parma, showing a drop in the arches toward the choir.

85 Plan of San Stefano, at Verona, showing a diminution of spacings toward the choir.

The following churches arranged under another head have the same features. Cathedral of Cremona, No. 120. Santa Maria at Toscanella, No. 140. San Pietro at Toscanella, No. 113. Cathedral of Troja, No. 110. Cathedral of Piacenza, No. 81.

The Cathedral of Parma also has this feature, in the pier spacings. So has Santa Maria in Pensola, at Narni.

The following churches have unmistakable schemes in arrangement of arch spans: the church at Palaja, Cathedral of Modena, and San Paolo Ripa d'Arno, Pisa.

CHURCHES WITH PAVEMENT SLOPING UPWARD TOWARD THE CHOIR.

The Survey can specify *eighty-five* churches in Italy which show this phenomenon. There are no publications extant known to the writer which have mentioned it. In view of the large number of observations it appears surprising that the existence of this phenomenon is not generally known, but there is no doubt that it has been so far neglected and overlooked. In some cases the arches also drop below the horizontal. In nearly all cases the lines of capitals and arches are brought down to the horizontal. In either case the effect is one of perspective illusion. The fact that the effect is naturally discounted by the eye into the slope which every level surface appears to have in perspective, is cer-

tainly the explanation of the general oversight. No doubt the peculiarity must be occasionally noticed and passed over by some casual observer as a local peculiarity, due to an unexplained local cause, but the assignment of any local cause becomes impossible when the observations are multiplied and collated. The discovery of this series of sloping pavements may therefore be reckoned as one of the most important discoveries of the Survey. It is a phenomenon known in Egyptian temples and is there ascribed by Egyptology to a purpose of perspective illusion.

86 Santa Maria della Vittoria, at Palermo. The pavement slopes up nine inches, the vaulting drops toward the choir between two and three feet. Both facts are discounted in the picture.

87 Section of the Church of San Pietro at Assisi showing the sloping pavement and drop in arches.

87a Photograph of the same church taken in parallel perspective to show the peculiarity.

88 Photograph of the same church looking up the nave and showing the effect as discounted into perspective.

89 Section of San Saba at Rome, showing the sloping pavement with arches built, and capitals set in a curve, dropping lowest at the choir end.

90 View of the same church looking across the nave, showing the peculiarity as viewed from the side.

91 View of the same church, looking up the nave and showiug the effect as discounted into perspective.

92 Nave of Santa Maria Ara Coeli at Rome, with the disk of the measuring pole set at the figure which measures the slope (over three feet). The effect is discounted in the picture.

93 View of the same church from the side aisle, taken in parallel perspective and showing the slope.

94 Section of San Giovanni in Zoccoli, at Viterbo.

95, 96 Views from the side and up the nave, as before.

Among churches previously illustrated the effect of the sloping pavement is discounted in the pictures of San Stefano, Pisa, and of the Siena Cathedral.

97, 98 Nave and aisle view in San Sabina, Rome. This church has the sloping pavement, which is thus dated to the fifth century. The effect is discounted in the nave view.

PLANS WITH WALLS OF THE CHURCH OR LINES OF NAVE CONVERGING TO THE CHOIR.

99, 100 Plan of San Stefano, Venice, and view of the church. This is a plan frequently adopted by theatrical scene-painters for increasing effects of distance.

101 Plan of San Giorgio in Velabro, at Rome, and views of the church, showing how the convergence is discounted by the eye.

102 Plan of Santa Maria in Cosmedin, at Rome, and views of the church, showing how the converging lines of the nave are discounted.

103 Plan of San Bartolommeo in Isola, at Rome, and views of the church. Another church of the above class, is San Antonino at Piacenza.

PLANS WITH WALLS OBLIQUE TO THE FAÇADE OR OTHERWISE DEFLECTED.

Notwithstanding the remarkable vagaries of these plans as seen on paper, they are not easily detected in fact, the effects being optically discounted. The photographs connected with these plans do not obviously differ from others, and they represent the appearance of the buildings as generally normal. There is undoubtedly a picturesque result in these plans, and there can be no doubt that they were intentionally constructed.

104 Oblique plan of San Nicolo, at Bari, and views of the church.

105 Oblique plan of Cathedral of Ruvo.

106 The ceiling of the church, photographed from below, to show the obliquity.

107 General view of the interior.

108 Exterior, with surveyor holding pole in order to show the amount of deflection in the wall from the normal line.

109 Oblique plan of the Cathedral of Troja.

110 Exterior of the church. Surveyor holding pole to show deflection of the wall from the normal line.

111 Oblique plan of San Giovanni in Zoccoli at Viterbo.

112 Interior of the church.

113 Oblique plan of San Pietro at Toscanella. Scheme in spacings and arches. The façade is bent in plan, the nave widens, as usual in the oblique plans. Views of the church interior.

114 Oblique plan of Santa Maria della Pieve at Arezzo. Observe position of the door and the incommensurate spacings.

115 View of the ceiling taken from the choir to show the deflected plan.

116 View looking up, and showing the oblique position of walls and arches in left aisle adjoining the choir. See No. 172, the crooked column, and No. 5.

117 Plan of Siena Cathedral with remarkable distortions. Compare the dome, No. 78.

118 Oblique plan of Orvieto Cathedral. Notice the measurements of chapels on the left.

119 Interior view.

120 Oblique plan of the Cathedral of Cremona. Observe the nave spacings.

121 View of the church, showing the bend in the piers. Compare No. 2.

122 Oblique plan of Santa Chiara at Assisi.

CURVES IN PLAN.

A "curve in plan" is a curve either in the lines of the ground-plan or in the upper lines of the building, which lies in an imaginary horizontal plane, whereas a

"curve in elevation" is a curve lying in an imaginary vertical plane. There is an important distinction between those curves of Mediæval Italian buildings, which are identical in delicacy and character with those known to Egyptian and classic antiquity, and those which, either from the novelty of their location and use, or from their ruder construction, are phenomena which might not appear to hasty observation to be related to the ancient classes of curves.

Strictly speaking, there are three classes of architectural curves in Mediæval Italy: (A) those which repeat exactly in delicacy and position the curves as known to ancient architecture: (B) those which rival the ancient curves in delicacy, but which vary from them in their use as regards the part of the building to which they are applied: (C) those which are rather bends than curves, and which might, in so far, be considered as careless building rather than as purposed construction

It must next be observed that it is an axiom of the architectural expert that a wholly regular and delicate curve in masonry can be due only to one of two causes: (*a*) intentional construction; (*b*) thrust of a vaulting. It is also possible that in a given building there might be some curves due to thrust, and others due to construction, or that a curve originally due to construction had been exaggerated by thrust.

CLASS A. CURVES IN PLAN CORRESPONDING IN USE AND POSITION TO ANCIENT CURVES.

123 View sighting on the curve of the Lateran cloister at Rome. The curve is found on all four sides, convex to the court, and in the cornice has possibly been exaggerated by thrust; but it is also found in the parapets, supporting the arcades on all four sides. These parapets are not subject to thrust.

124 Similar curve in the cloister of San Paolo fuori le Mura at Rome. Here there are no curves as regards three of the parapets, but there are cornice curves convex to the court on all four of its sides, and the masonry shows cutting and fitting intended to produce the curve.

125 Group of photographs showing the masonry cutting and fitting of the above cloister curves. Some of them relate to a system of 'working in' the curve of the cornice by leans accented at the centre of each side. Others show the jointing of masonry in the cornice, producing the curve.

A Shows the forward lean of a column, to be tested by the plumb-line in the picture.

B Shows the capital of such a column cut to a horizontal at the top. This shows that the lean, to be tested by plumb-line, is not accidental. If the lean were accidental the top of the capital would tilt forward.

C Similar capital. Observe the cutting and the divergence of the necking fillet which slopes down, from the cutting of the abacus, which slopes up. This is also apparent in B.

D Shows the jointing of the cornice by which the curve is produced.

E Shows similar facts.

F View from the above cloister, bearing on question of thrust. Of two columns here seen, the outer one leans forward; the rear one does not. Observe the divergence of their lines. This proves that the lean is not due to thrust of the vaulting, in which case both columns would lean forward.

126 Cloister of Sassovivo, near Foligno. View sighting on the curve of the cornice convex to the court. This curve was first observed in an Italian photograph by Mr. Nelson Goodyear, and this led the Survey to visit Sassovivo. Each side of the court has the same delicate and regular curve.

A Leaning columns of this cloister, showing how the curve above is produced by forward leans toward the centre of each side. The bases of these columns show no evidence of grinding or repair.

127 Cloister of the Certosa, near Pavia. The photograph does not show the curve, but illustrates the proof of construction. The parapets have curves on all four sides, convex to the court The Survey does not assert that these curves are visible in the cornice, and it would not appear from the length of the sides and the character of the terra-cotta work above that any curve could have been intended for effect on that line. In other words, thrust cannot even be considered as an element of the problem. *This Cloister is Fifteenth Century Renaissance*, a remarkable survival of the curves.

128 Cloister of San Zenone, Verona. Curves "in the lines of the columns," reported by Mr. Nelson Goodyear; not seen by the Survey, but the report eliminates thrust.

129 Cloister of the Celestines, Bologna. A decisive case—(*a*) because there are no leans to complicate the problem of intention; (*b*) because the curves (as usual, all convex to the court) are found from *top to bottom* in the brick walls of a two story cloister; (*c*) because on one side of this cloister there are no vaultings on either story and no thrust can be suggested. *The measurements in this cloister were made at the earth's surface.*

The most exact and direct analogy to the above cloister curves is the curve in the cornices of the court at Medinet Harbou, found by Pennethorne. (See "Architectural Record," for April, 1895.) The use of curves in plan in Greek temples is attested by Jacob Burckhardt for Paestum (see No. 300), and by Burnouf for the lines of columns in the Parthenon. It is attested for the Roman period by observations on the *Maison Qarrée* at Nimes. (See "Architectural Record," April, 1895.)

130 Cornice curve, in the portico of San Giorgio in Velabro, Rome. Such cases are very numerous. It is not generally easy to find them wholly free from possible suggestions of thrust. Hence the importance of the next picture.

131 View looking up, inside the above portico, to show a timber truss-work not exercising thrust.

CLASS B—CURVES COMPARABLE TO ANCIENT CURVES IN DELICACY, BUT DIFFERING FROM THEM IN NATURE OF USE.

The differences do not appear to spring from anything but difference in the character of the buildings—for instance, the difference between a temple with exterior porticos and a church with exterior walls. We have no remains or records as to curves in the interiors of temples. All these differences therefore may be simply gaps in the record, due to the destruction of the classic buildings. It is not, however, the purpose *of the Survey* to establish correspondence or historic continuity, however probable this may appear. The facts are the main thing.

132 Curve in plan *beginning at the foundations.* San Paolo Ripa d'Arno at Pisa.

133 Curve in plan in the alignment of columns extending through the entire walls of the clerestories. Plan of the Cathedral of Fiesole, with survey for the curves. The photographs attached do not clearly show the curves, as they are discounted by the optical effect, but they are very clear to the eye when sighting nearer to the walls, and were thus discovered.

134 The left line of columns in the above Cathedral. View looking back from the steps going up to the choir, and show the curving line of the bases.

135 San Apollinare Nuovo, at Ravenna (Sixth Century church). The ancient mosaics show that the walls have not moved. The curves in this church are parallel, the right line convex, and the left line concave, to the nave. They begin at the foot of the columns and extend through the clerestory walls; six inches deflection at the center. The Survey of San Donato, at Genoa, offers another case exactly parallel.

136 The curve at Trani. It extends from the bases of columns to the ceiling of the church.

137 The left line of columns at Trani showing the curve in the bases.

138 The curve in Santa Agnese, at Rome, both galleries convex to the nave. Parallel curves in both gallery walls, a clear case against thrust.

139 Curve in the Cathedral of Genoa. It is also found here in the bases of the supporting columns.

140 Plan of Santa Maria, at Toscanella. Survey for the curve in plan, of the left line of columns. The right wall has a parallel curve, not found in the columns.

141 Curve or bend of the left wall of this church. Sighted from the pulpit. For general view of the nave, see forward.

142 Curve in plan of the south wall, Pisa Cathedral, from the pavement. See plan, No. 28.

143 The same curve, sighted from the roof.

144 Plan of the galleries, Pisa Cathedral, showing the curves in the plan of the main galleries, of the aisle columns, and of the outer walls. The columns supporting these galleries have all been plumbed to test the possibility of thrust in the supporting aisle vaults, with results negativing

thrust. Different columns lean in different and opposing directions at the points examined for thrust.

145 Pisa Cathedral galleries, north aisle, line of columns sighted to show the curve, with a straight line laid down by the Survey to assist the illustration of the curve.

146 Pisa Cathedral, south gallery, view sighting on the curve, *from within*, which is concave to the nave without.

147 Pisa Cathedral, south gallery cornice. View sighting on the curve in plan. A line laid down by the Survey to assist the illustration was accidentally moved slightly away from the curve. This curve is, more properly speaking, a bend, and belongs to a class, showing rougher construction. It cannot, however, be considered accidental, when all the facts are correlated. These plans and pictures show that the gallery cornice lines of the Pisa Cathedral correspond to the curves found at Fiesole, in San Apollinare Nuovo at Ravenna, in San Donato at Genoa, in Santa Maria at Toscanella, etc., as regards the correspondence of a convex line on one side to a concave line on the other. These plans grade over into the deflected plans like those of Santa Maria della Pieve at Arezzo by various transitions, such as the next.

CLASS C. BENDS RELATED TO THE FOREGOING CURVES, BUT GRADING INTO THE MORE PROMINENTLY DEFLECTED PLANS ALREADY ILLUSTRATED.

148 Siena Cathedral ; view sighting on the bend of the choir. *Similar bends in the nave*, parallel to one another.

149 Photograph from a broken negative, showing the bend in the left cornice of the Siena nave. The words left and right invariably apply to the church viewed from the façade toward the choir. Here the bend is seen on the right of the picture.

150 Gallery bend in the Orvieto Cathedral.

151 Gallery bend in the Orvieto Cathedral. A rare case where both lines are concave to the nave. Such lines might be considered as careless construction, but they appear to be gothic survivals of older traditions. For undoubtedly intended irregularities at Orvieto see Plan No. 118, The phenomena must be viewed as a whole.

152 View sighting on the curve in plan of the façade of St. Mark's at Venice (ten inches deflection) concave to the piazza.

153 The same curve sighted from the level of the pavement.

The simplest possible explanation for all these bends and curves would be asymmetry, dislike for straight lines as too cold and formal. This point of view may be more widely applicable to Egyptian, Greek and Roman curves than has been heretofore supposed. *It must be remembered that there are as yet no universally*

accepted explanations of ancient curves. In so far as optical theories have heretofore been offered for ancient curves, they are of two kinds, theories assuming optical correction and theories assuming optical illusion. Both theories are conceivable *for antiquity, for different cases.* There do not appear to be any cases in medieval building where optical correction was intended. There are many cases where optical illusion may be conceived as intended. The proof that optical illusions were otherwise undoubtedly employed, has some bearing on the question. The proof that asymmetry was otherwise undoubtedly employed has also bearing on the question. From the standpoint of history, which is the most important one of all, it appears to be proven that the mediæval curves and bends are continuations and developments, through Byzantine influence, of the ancient ones, varied by mediæval exaggerations, carelessness, or caprice, according to periods of time, or more or less close relation to Byzantine centres; and also varied according to the difference in character of mediæval buildings from those of antiquity.

CURVES AND BENDS IN ELEVATION.

The main argument for purpose in these phenomena is that they are *all* convex to the sky line in exteriors or convex to the roof line in interiors. In other words they are all concave to the spectator, as regards the upper lines of the buildings; in which upper lines they mainly occur. Accident is hardly to be assumed under these conditions. The possibility of thrust or settlement is rarely present, and no case is presented where this question has not been carefully examined. As regards optical effect it is true optically that the effect is the same as that of every bend or curve which is convex to the spectator and above the line of vision. As regards the purpose the Survey is non-committal. If not optical it *must be* asymmetry. Asymmetry is a matter of optical prejudice, but distinct from conscious theories of optical effects. The optical effect of every curve concave to the eye on the plane of vision, or convex to the spectator above the plane of vision, is undoubtedly an illusive effect of perspective. That traditional habits of building, begun in Byzantine centres with underlying consciousness or knowledge of the optical result, may have been continued or adopted by other mediæval builders as a matter of tradition without such consciousness, is a possibility.

All buildings examined by the Survey which show a bend or curve in elevation belong to the Byzantine Romanesque, and with exceptions at Cremona, Ferrara and Vetralla, they can be directly related to centres of Byzantine influence. The importance of this fact cannot be over-estimated, as bearing on the question of carelessness or accident. If the curves were accidental they would be equally numerous in the Gothic.

154 Gallery bend of San Marco at Venice. Every gallery of the church has this upward curve. It is verified by the Survey that these curves are not due to settlement of the piers.

155 Curve in elevation, view on the roof of the Pisa Cathedral.

156 Curve in elevation, view on the roof of the Pisa Cathedral.

157 Curve in elevation, cornice of San Sisto at Pisa.

158 Curve in elevation, left side of San Michele at Lucca.
159 Photograph of the above in parallel perspective.
160 Detail of the masonry of this curve showing its careful jointing.
161 Survey of a bend in elevation, San Alessandro at Lucca.
162 Photograph of the same.
163 North gallery bend in elevation, Pisa Cathedral.
164 The same taken from the nave.
165 Upward rise of this bend from the façade gallery to the fifth bay.
166 North gallery bend, another view.
167 South gallery bend, Pisa Cathedral.
168 South gallery bend, Pisa Cathedral, as it rises from the façade gallery to the fifth bay.
169 General view of these bends from the façade gallery, showing how they tend to merge into the perspective, even as seen from above.
170 Irregular curve of the masonry lines on the side of the Cathedral of Ferrara. Considered as an isolated case, this might be attributed to careless and irregular building. Viewed with other cases, it may be considered as rougher building than usual, of a curve in elevation.
171 North aisle columns of the Pisa Cathedral, with plinths arranged in a regular curve rising from each end to the centre. The camera could not be moved back to include all the bases, and the facts are not very clearly indicated, as they are discounted by the eye. Therefore, see also Survey of the Pisa Gallery levels, including this phenomenon. The chances against an accidental arrangement producing such a curve are enormous. Similar arrangement, but not quite as regular, in the south aisle.

CASES OF ASYMMETRY.

172 Crooked column in the exterior choir gallery of Santa Maria della Pieve at Arezzo. Its significance rises when connected with the apparently capricious arrangements of the ground-plan of this church, No. 114, and with its leaning piers, No. 5.
173 View in the south transept of the Pisa Cathedral, displaying the asymmetry found in the masonry of the arches as regards the use of color. All views of the Pisa Cathedral will show a purposely irregular arrangement of the bands of color in piers, walls, etc.
174 South transept of the Pisa Cathedral (from the north transept). The columns on the right (west side) average two and a half feet higher than those on the left (east side) of the south transept. This is a case of 'putting the best foot forward.' The larger columns are those which face the spectator who enters by the door of Bonanus and are accepted by the eye as standards for all the other transept columns. The Survey gave four weeks' work to the Pisa Cathedral, before this trick was noticed.

Many cases of asymmetry merge into the well-recognized and beautiful varieties in the detail ornament of mediæval buildings, as illustrated in the following Catalogue numbers.

MEDIÆVAL ARCHITECTURAL DETAILS AND VIEWS.

North Italy.

175 Pisa Cathedral. South transept apse, in parallel perspective.
176 Central door of façade.
177 Detail of a column of this door.
177a Another detail of the same.
178 Detail of an arch of the façade.
179 A capital from this arcade.
180-182 Details of the bronze doors by Bonanus, the architect of the Leaning Tower.
183-187 Details from the façade of San Michele at Lucca.
188-192 Details from the façade of San Martino at Lucca.
193-197 Details from the portals of Lucca Churches. The first three numbers are from Santa Maria Bianca. The last two numbers are from San Giusto.
198 An Ionic capital from San Frediano, Lucca. A remarkable case of mediæval Ionic.

Central Italy.

199-201 Views in the interior of San Marco at Venice.
202-213 Views and details from San Pietro at Toscanella.
214-219 Views and details from Santa Maria at Toscanella.
220 Door of the Cathedral, Assisi.
221-222 Capitals from Vetralla.
223 Cloister of Sassovivo.
224 Façade of Siena Cathedral.
225 Bull, detail from the Siena façade, in the cathedral museum.
226 Fragment of the Siena Cathedral pavement, a Cherub, in the cathedral museum.
227 View of the Siena Cathedral pavement from the gallery.
228 Plan of the Siena pavement.
229 Perspective in San Paolo fuori le Mura, Rome
230-231 The cloister of San Paolo.
232 Lateran cloisters, Rome.
233 Tabernacle of San Giorgio in Velabro, Rome.

South Italy.

234 Cathedral window at Bari.
235 Main door of San Nicolo, Bari.
236 Tabernacle of San Nicolo.
237 Side door of the same church.
238 Main door, Trani Cathedral.
239-242 Capitals from Ruvo.
243-250 Views and details of the Cathedral of Troja.
251 Detail of the pulpit, Ravello Cathedral.

ANCIENT ART.

Museums of Perugia, Chiusi and Volterra.

252 Museum of Perugia. Gorgon head in terra-cotta
253 Etruscan cinerary chest, terra cotta. 253a another view.
254 Mirror-case of silver. Bacchus on a panther.
255 Etruscan sarcophagus, a goddess of death seizing the deceased.
256 Museum of Chiusi. Etruscan cinerary chest, with relief, probably a combat from Homer.
257–263 Museum of Volterra. Etruscan cinerary chests with reliefs.
257 Rape of Helen.
258 Ulysses and the Sirens.
259 Hunt of Meleager.
260 The Last Journey (represents the departure for the spirit world).
261 A Griffin, personifying death, seizing a victim.
262 A Centaur
263 The Rape of Persephone.

Ancient Art. Rome, Naples and Pompeii.

264-270 Museum of the Baths of Diocletian. Series of stucco reliefs from the excavations in the grounds of the Farnesina Villa.
271 Court of the Naples Museum. Views from the various galleries follow.
272–274 Rooms of the small bronzes.
275 Hot water boiler from Pompeii
276 Gallery of the Greek vases.
277–283 Galleries of sculpture.
284–285 Galleries of frescos and mosaics.
286 Pompeiian fresco, Hercules finding his infant son, Telephus, suckled by a hind.
287 Pompeiian mosaic, street musicians.
288–294 Stuccos from Pompeii. Naples Museum.
295–298 Stuccos in the Baths of the Forum and of Stabiæ at Pompeii.
299 Figure of Atlas from the Baths of the Forum.

Ruins of Paestum.

The views of the Neptune temple include the first photographs ever taken on this site for Greek curves.

300 View sighting on the curve in plan, of the temple cornice. (The Neptune temple is the only surviving temple of *Greek* architecture having cornice curves in plan, as distinct from the better known curves in elevation.
301 View of the side elevation in parallel perspective, showing the optical effect as a rising curve, *i. e.*, a curve in elevation.
302 Front view of the Neptune temple in parallel perspective.
303 General view of the Neptune temple.
304 Neptune temple, showing the curve in elevation of the stylobate.

Views from Sicily.

305 Girgenti. The temple of Concord, showing the curve of the stylobate on the flank.

306 The temple of Concord, side elevation in parallel perspective, showing the curves.

307 Temple of Concord, front view, parallel perspective.

308 Girgenti. Temple of Juno, side elevation, in parallel perspective, showing the curves.

309 Girgenti. Ruins of the temple of Jupiter. Fragments of one of the Giants (supporting figures of the interior) collected together.

310 A Doric capital, in two pieces, as originally made, with figure of the custodian as standard of size.

311 View of a portion of the exterior wall showing bases of the engaged columns. This dates the engaged column to the fifth century, B. C., in Greek architecture, a fact not generally known.

312–313 Views at Selinus, ruins of the Greek temple of Apollo, so-called. Ruins of the temple of Hercules, so-called.

314 Views from Egesta, side elevation of the temple in parallel perspective, showing the curve.

315 The stylobate, showing the curve.

The views from Sicily include the first photographs ever taken for Greek curves on that Island.

The Pantheon at Rome.

316 Curve in elevation of the front entablature of the Pantheon, discovered by the Brooklyn Institute Survey.

317 Another view of the same.

Attention is called to the 8 x 10 prints, which are not catalogued, unless displayed on the walls.

GENERAL FITZHUGH LEE.

Some Facts About Our New Consul General to Cuba---A Chat With Him About the South and the War.

WASHINGTON, D. C., June 6, 1896—Before this letter is published General Fitzhugh Lee will probably be in Havana acting as the American consul general and also as personal confidential adviser to President Cleveland as to the Cuban troubles. He will for the time have the most important diplomatic post under our government, and he is [illegible] especially fitted for the position. General Lee is a man of high culture, a soldier of experience, and his life has been spent in dealing with public men and affairs.

I spent a morning with him here in Washington shortly before his appointment, and had a chat with him about himself and public [illegible]. Just before meeting him I had [illegible] over his "Life of Robert E. Lee," and [illegible] of this brought out some of his own war experiences which have never been given to the public. He has, you know, had some of the most narrow escapes of any man now living. Three horses were shot from under him in the battle of Winchester, and he has been wounded again and again, both in his [illegible] and in the war of the rebellion.

Pen Picture of Fitzhugh Lee.

As I looked at General Lee I could not realize [illegible] rather does not compare with the idea of battle scars, and [illegible] his low, sweet voice was that which in other times gave the orders to the brigades under him when he was the chief cavalry general of the Southern confederacy. The pictures give you but little idea of the man. You need the colors of a Titian or a Rubens to bring out his characteristic features. General Lee has a complexion [illegible]

GENERAL FITZHUGH LEE.

[illegible]

Fitzhugh Lee's Great Indian Fight

[illegible]

"Virginia Back Heel Trip."

[illegible]

How Fitzhugh Lee Entered the Confederacy.

[illegible]

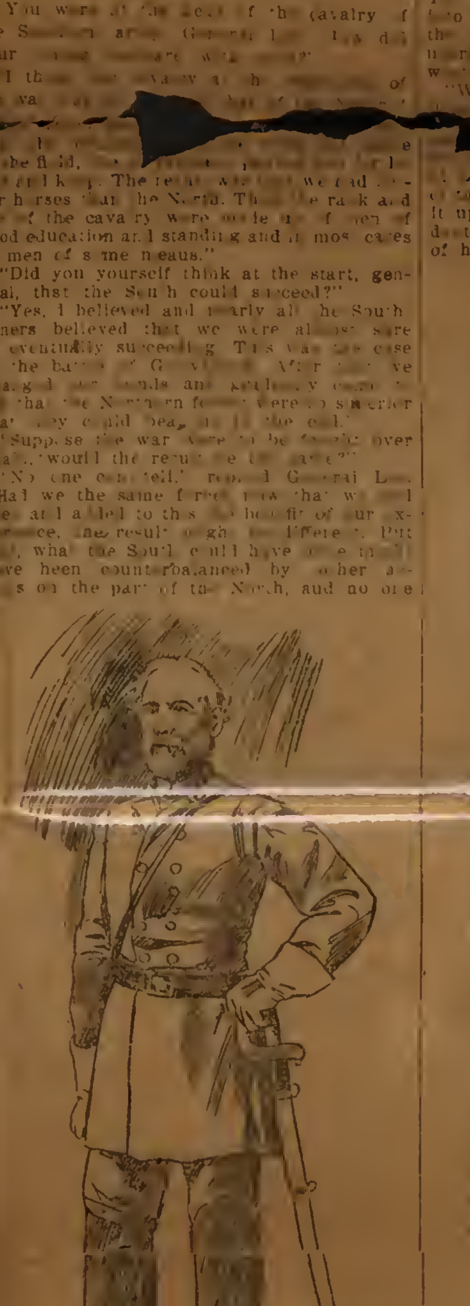
sign my services to the Union army. He replied: 'Well, I'm going to Washington to offer mine, so we may as well travel together. You can act as the chief if we are stopped by the Southerners, and I will do my part if there is any trouble with the Northerners as to our getting through the lines.' I agreed to this and we traveled together. At Havre de Grace we found the railway torn up and had to take a steamer and go via Annapolis, taking the railway from there to Washington. As we attempted to take the steamer we were told that we could not go on board without a pass, and that no one could be carried without and order from General Ben Butler. Butler had charge of the town and he was allowing only Unionists to go through. As I heard this I said: 'Well, Major Kearney, that's your business.' Kearney said: 'All right,' and leaving me in charge of the baggage, he went up town and soon returned with passes for Major Kearney and friend. My name was not mentioned. With these passes we easily got through to Washington. I went at once to the war department and reported and was told that there were orders there for me. These directed me to go to my regiment, but, I said in reply that my regiment was in Texas. I was informed that it was not, and that it had just arrived at Carlisle, Pa.

The Story of a Saddle

[illegible] resigned at once," continued General Lee. "I had, however, an army saddle in Philadelphia, which I was very anxious to get. I was something of a horseman, and I wished to use the saddle during my service in the South. When I received the orders it seemed to me that I might go to Carlisle and march back to Washington with my regiment. [illegible]

The Cavalry of the North and South.

[illegible]



GENERAL ROBERT E. LEE.

The Solid South and the Negro

[illegible]

least, a condition which the people of the South could not endure."

Grant and Lee

"You were close to General Lee during the war, were you not?"

"Yes," replied Fitzhugh Lee. "I was his nephew, and we were naturally intimate friends."

"You were with him at the time of Appomattox. Did the surrender take place, as it has been described, under that apple tree?"

"No," said General Lee. "The apple tree story arose from the fact that General Robert E. Lee was lying under an apple tree upon a blanket near the Appomattox court house when a messenger came to him from General Grant. [illegible] General Lee and secured a room in Mr. Wilmer McLean's house in Appomattox. This was a two story brick, with a porch running along in front of it. General Grant arrived there at about 1 o'clock that day, and the surrender took place in that room. [illegible] and Lee at a small oval table near the window. They had met once before, years before, during the Mexican war. [illegible] reduced to writing."

General Lee's Sword

"General Grant did not take General Lee's sword?"

"No," was the reply. [illegible]

What became of General Lee's spurs?" asked.

[illegible]

Lee After the War.

[illegible]

FRANK G. CARPENTER.

LAST OF THE IROQUOIS

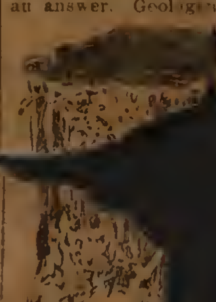
[illegible]

STRENGTH OF ITALIAN WOMEN

Three Italian women at a Fifth avenue corner were preparing to carry away about one cord of seven lumber that had lain thrown [illegible] [illegible]

ASBESTOS AND ITS USES

THERE is probably no [illegible]



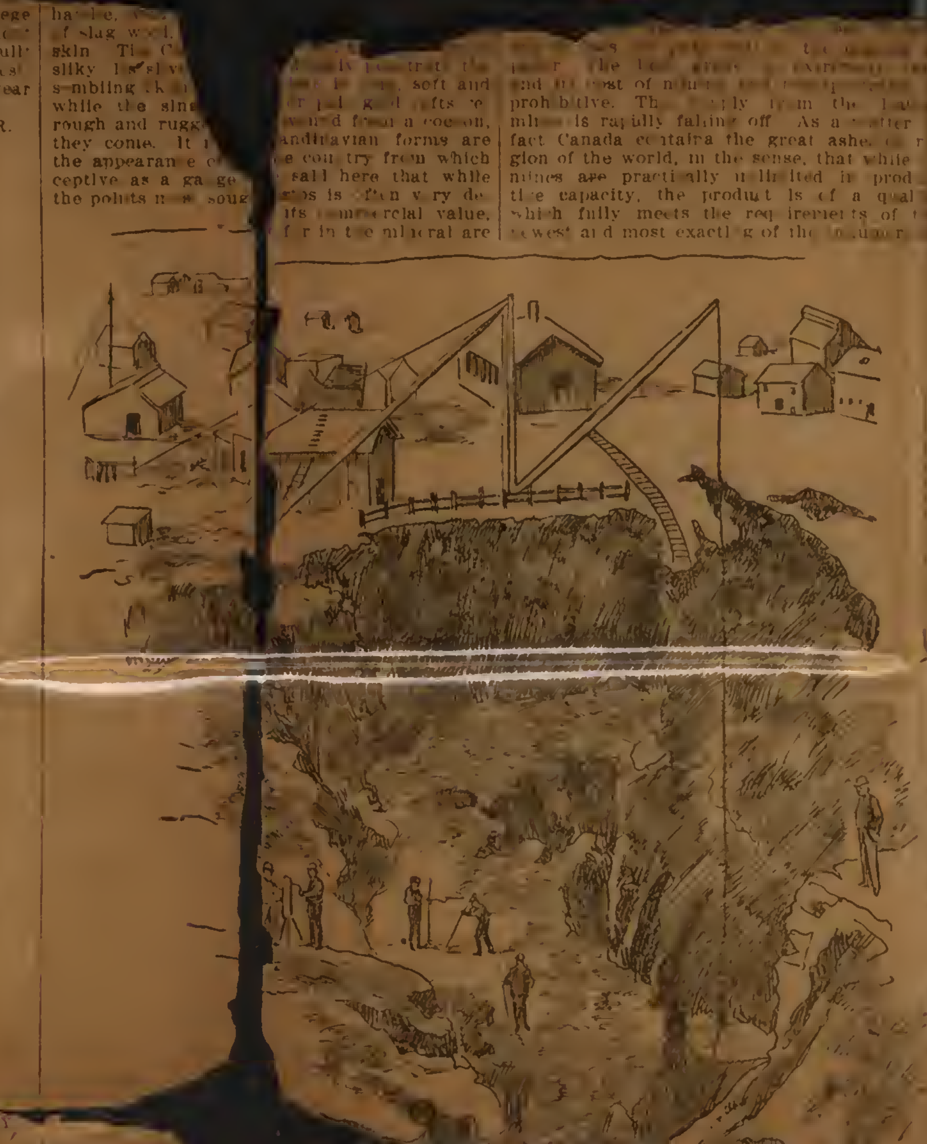
[illegible]

Where Asbestos Is Found.

[illegible]

Canada the Great Asbestos Region of the World

[illegible]



Typical Asbestos Mining Camp in Canada.

The Principal Varieties

[illegible]

a succession of sifters and separators, which tear, strip and clean the fiber until it is ready for the different departments for which it is to be graded. It is then taken up by blowers and shot up by a feathery, snow like stream into canvas bins. Nothing more beautiful than the material at this stage can be imagined. What a few moments before was dark, cheesy rock, has been transmuted into a white, shining mass of delicate, quivering down.

Its Manufacture and Its Innumerable Uses.

The process of manufacture is intensely interesting, more especially from the fact that as the industry is constantly entering upon novel phases, new methods of treatment and special machinery have to be devised. But a description of these would carry this part of the subject to too great a length. It will suffice to say that the asbestos is graded in the [illegible], according to its length of fiber. No. 1, which is the highest grade, is used for carding, spinning and weaving. No. 2 is used to some extent for carding as well as for cement, and for pipe covering and as a substitute for No. 1 where the material permits of a shorter fiber. No. 3 is used largely in paper and for many kinds of filters. One of its special uses is for wall plaster. This is a new application which will have a [illegible] effect in modifying the practice of indoor plastering. Instead of the ordinary tedious and elaborate preparation of sands and straps, and the use of inferior and [illegible] mortar with [illegible] after [illegible], which is necessary to give cohesion to the final coat of plaster of paris, a single coating of the asbestos is laid on. It has a glossy surface that will not crack, as, while firm it is perfectly flexible. It can be put on the raw brick; and a room of which the walls have been built in the morning can, before night, have a smoothly finished interior surface shining like glass and hard as a rock. A kindred application of asbestos is now coming [illegible] in the shape of [illegible] walls and ceilings. [illegible] They are embossed in very beautiful designs and can be treated with gold, varnish, lacquers or any other substance, for the enhancement of their ornamental effect.

The applications of asbestos are now so infinite that it is impossible to enumerate them here, but a few of the more important of them may be mentioned. [illegible]

Asbestos for Electrical Purposes

[illegible]

FOLK FLOWERS.

[illegible]

QUESTIONS ANSWERED

CORRESPONDENTS should not feel disappointed when their questions are not answered immediately, as the information solicited frequently requires considerable research, for which some time should be allowed.

The name and address of the writer should accompany every question.

Notes—"E. M." The [illegible] strength of cast iron is from 4,000 to [illegible] pounds to the square inch, of wrought iron [illegible] pounds per square inch, and [illegible] steel (maximum) 142,000, [illegible] Bessemer, hammered. [illegible]

"Inquirer" [illegible] It is the crystal [illegible] of the excess of vapor in the atmosphere [illegible] when the temperature is below freezing. Hail and sleet are frozen rain.

"G. R." [illegible] senate on Wednesday, March [illegible], by a vote of [illegible], the assembly [illegible], March 2[illegible], and was [illegible] over the mayor's veto on W[illegible], April 22.

"H. S."—For [illegible] New York or elsewhere, it is [illegible] your family [illegible].

"E. J. S."—In all questions of law, whether they are in regard to real or hypothetical cases, it is best to have the opinion of a lawyer in full practice.

"J. P. L."—The records of [illegible] entries made September [illegible], were: [illegible] 49 seconds, [illegible] ran with tracks [illegible] against a [illegible] Eagle Almanac [illegible]

"A Reader"—[illegible] between each of the [illegible] two in explanation of [illegible].

To the Editor of the Brooklyn Eagle:

During the past winter the [illegible] contained a story by the late R. L. [illegible]

[illegible]

To the Editor of the Brooklyn Eagle:

[illegible]

WILLIAMSON.

[illegible]

A GREAT ARCHITECTURAL COLLECTION.

The Institute Will Possess the Results of Professor Goodyear's Discoveries in Italian Art.

WHEN the museum of art of the Brooklyn Institute opens its doors next winter, it will occupy a unique [illegible] among the museums of the country. Like many other good things, great art museums are not made; they grow; yet it is more than likely that the new institution will at once take a commanding place among its fellows because of the simple fact that it will contain the results of a series of extraordinary discoveries in Italian medieval architecture.

About fourteen months ago Professor William H. Goodyear, formerly curator of the Metropolitan museum of art, submitted a proposition to the Brooklyn Institute to make at his own expense a survey of more than a hundred Italian churches and cathedrals, provided the institute paid the hire of an expert with the compass and camera. Such an expert was found in the person of John W. McKecknie, the well known architect and teacher of design. The party sailed for Ge[illegible]

[illegible] but [illegible] the question open whether the [illegible] really sloped or the arches underneath it fell. He ventured the opinion that the facade of the cathedral had settled. Not so young Goodyear. "Not knowing what the [illegible] of the [illegible] meant or how it got there," says he, "I went around the city looking at all the walls and the buildings. Finally I came across a little church known as San Stefano Outside the Walls, and I noticed a cornice with large arches at one end and constantly diminishing ones toward the other. It occurred to me that I should go inside the building. I did so and found a tremendous scheme of dropping arches all in a little village church that is never visited by foreigners. It gave me the hint that something of the kind was going on in Pisa cathedral."

Mr. Goodyear returned to Pisa and spent a week in observations and [illegible]. His work established several conclusions [illegible]. First, that the cornice [illegible]. Second, that there is a corresponding drop in arches, [illegible] on the [illegible] a [illegible]. Third, the west front of the cathedral leans forward from the perpendicular about fifteen inches. Fourth, that the heavy middle string course of the side walls is oblique by construction. Fifth, [illegible]

PISA [illegible]

(Br[illegible] W. [illegible])

which proved that the inner courts of the Egyptian temples at Karnak, Luxor and F[illegible] bulge in convex curves to the ce[illegible] and that the cornice of the Maison Carree, an old Graeco-Roman temple at Nimes, France, curves convexly to the beholder. These were bits of evidence in a chain which Professor Goodyear now thinks firmly forged.

While professional and scientific men felt an interest in Professor Goodyear's earlier theories and observations, they and laymen alike, knew that the investigations must be broader in character and of an accuracy expressed in the finest measurements to [illegible] epoch making significance. To use [illegible] [illegible] should be attached to the phenomena [illegible] and this was necessarily reserved for a la[illegible] survey, [illegible] three

NORTH GALLERY BEND, PISA CATHEDRAL.

LEANING TOWER OF PISA.

First Picture Ever Taken From the Cathedral Choir and Showing the Well in Which the Tower Stands.

(Taken by John W. McKecknie for [illegible])

[illegible] m[illegible] of [illegible] work [illegible] the [illegible] of Italy, explored [illegible] and studied equally the [illegible] and the [illegible] accessible and [illegible] monuments. Upon their return to America Professor Goodyear and Mr. McKecknie set to work to prepare their material, the former for publication to the scientific world, the latter in the way of survey drawings and enlarged photographs for public exhibition. This task is now nearly completed. During the present week the friends of the institute and the general public will be afforded an opportunity to view surveys and photographic enlargements at the Art building on Montague street.

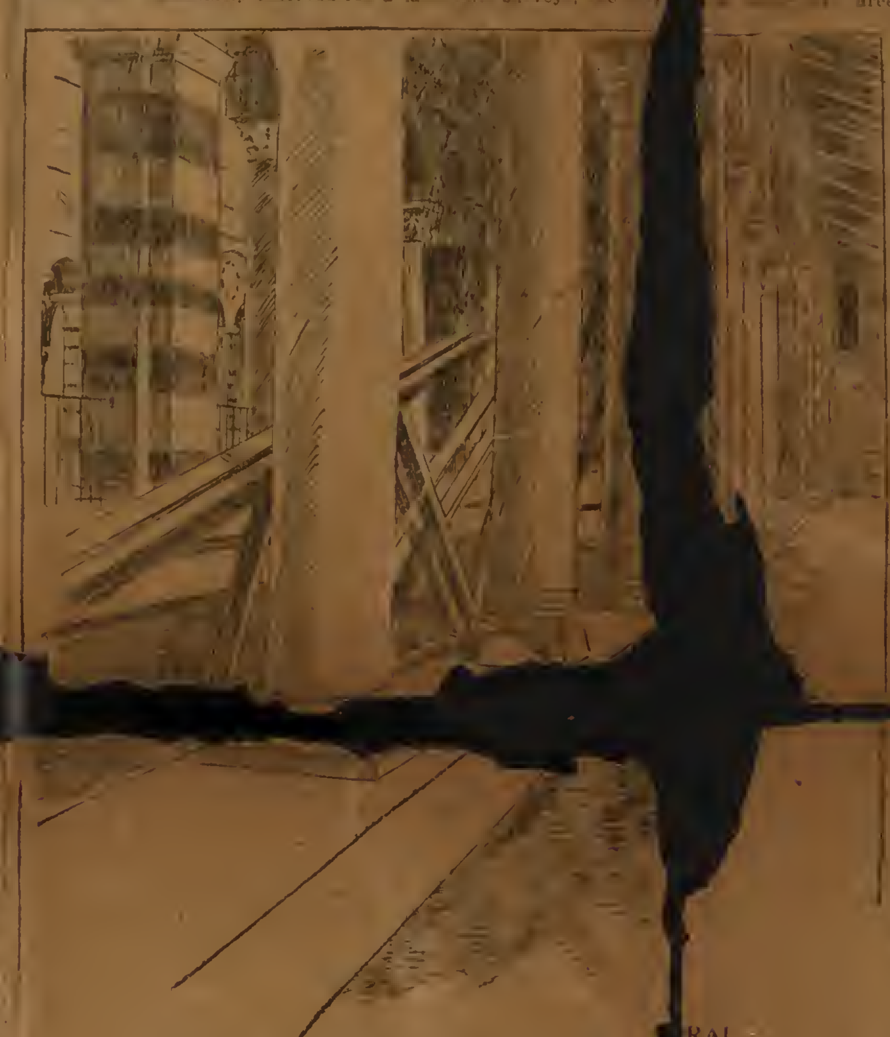
Before speaking in detail of Professor Goodyear's discoveries, it is necessary to mention one fact concerning them. Taken all in all, they revolutionize our ideas of mediaeval architecture. Behind the obvious scheme of middle age building they show us a subtler architectural scheme which has escaped the notice of Ruskin as it has escaped the notice of every other critic and savant who has studied the subject. They indicate a knowledge of perspective effects and perspective illusion, of which our modern architects appear to be entirely ignorant, and the absence of which may account for the cold [illegible] the Byzantine, the Greek and the Egyptian in one common link, demonstrating anew the continuity of art.

In the year 1870 William Henry Goodyear, then a young man of 24, was on a short trip in Italy, after three years of post graduate study in the German universities. Pisa chanced to be the first town that he visited. Pisa has three great buildings, the cathedral,

[illegible] [illegible] work, [illegible] Goodyear found himself [illegible] world, [illegible] every [illegible] was curved and almost every curved line [illegible] straight, and where the evidence of the eye and the evidence of the measuring rod constantly contradicted each other.

He realized at once that no theory of masonry thrust or of settling foundations could account for the strange phenomena. He determined to visit edifices in other parts of Italy to ascertain if the Pisan style of architecture were peculiar to that town. He saw Florence, Pistoja, Venice, Ravenna and Rome, and although the time at his disposal was limited and some of the localities he visited were not suited to the best observations he gathered enough to convince himself that the phenomena discovered in Pisa were not exceptional and that their probable origin was Byzantine.

In 1874 Professor Goodyear embodied his discoveries and deductions from the [illegible] of Pisa in an article in Scribner's magazine, entitled "A Lost Art." Professor Charles Eliot Norton of Cambridge encouraged him in the prosecution of further labors by [illegible] contribu[illegible] [illegible] In 1879 he delivered a lecture on "Mediaeval Architectural Refinements," before the Century club in New York and afterward before the Society of Boston Architects, in which he not only repeated his former conclusions, but advanced a theory accounting for the purposes of curvilinear building. In the eighties one of the New York learned societies commissioned a Mr. Newton of Boston to take further measure[illegible]



NORTH GALLERY CURVE, PISA CATH[illegible]RAL.

(Brooklyn Institute Survey. Taken by John W. McKecknie)

[illegible] which from 1870 on I was constantly [illegible] to accomplish." When after twenty [illegible] years of waiting the way was open through the co-operation of the Brooklyn Institute, Professor Goodyear laid his plans [illegible] a careful survey of [illegible] [illegible] the photographer's art, so far as [illegible] arrangements were made for [illegible] camera is [illegible] which the camera is [illegible] can be reproduced on the page with any degree of faithfulness. All the other points are in a measure distorted. Moreover, the practice of photographing at almost any angle produces obliquities in the picture where the real lines are straight and vice versa. To [illegible] difficulty Mr. McKecknie devised a [illegible] of photographing with compass and camera.

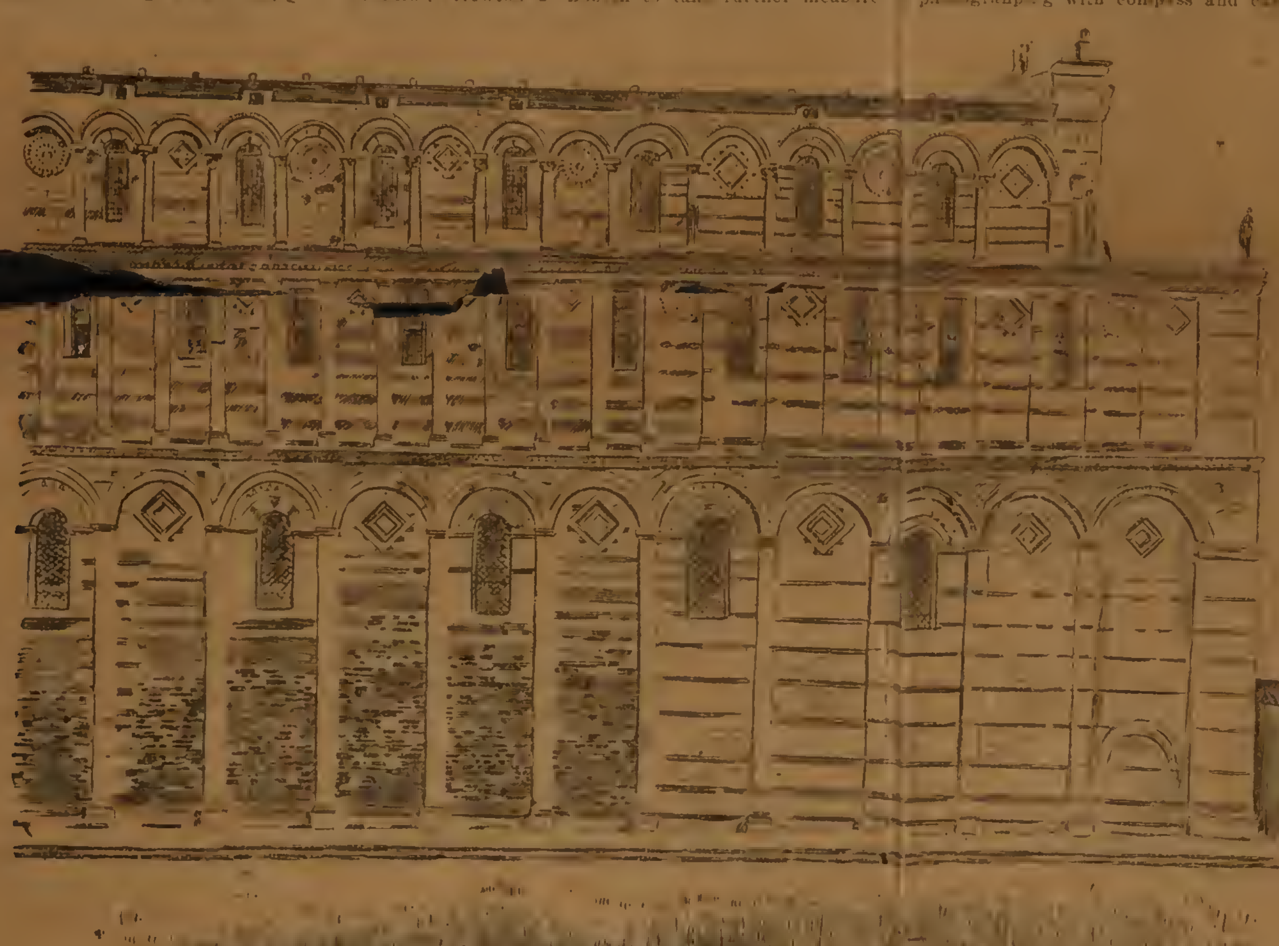
SOUTH GALLERY BEND, PISA CATHEDRAL.

[illegible] ed

[illegible] evening [illegible] on [illegible] the [illegible] fine [illegible] The remaining lectures will be given on Wednesday evening, June [illegible], and [illegible] evening, June 13, and will be open to all members of the Brooklyn Institute. The exhibition of Mr. McKecknie's enlarged photographs and surveys will [illegible] Tuesday evening, June 9, and will continue until June 25.

IN THE PEACEFUL QUAKER CITY.

A long eared mule, which had evidently [illegible] away from home, [illegible] a long block [illegible] the trolley [illegible] on [illegible] street, near [illegible], last evening. Growing tired of his [illegible] he [illegible] that it would be a good thing to [illegible] and take a [illegible] selecting the center of the [illegible] his [illegible] [illegible] mule [illegible] car was [illegible] almost on top of him, when he raised his head, wagged his ears, winked solemnly at the motorman and calmly resumed his former position. No amount of [illegible] his



OBLIQUE LINES, BENT LINES AND LEANING FACADE, PISA CATHEDRAL.

(Brooklyn Institute Survey. Taken by John W. McKecknie)

DROP IN LINE OF ARCHES, SAN STEFANO, BOLOGNA.

the baptistery and the leaning tower. The young man [illegible] [illegible] of the cathedral at Pisa, the result [illegible] [illegible]